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PHASE I REMEDIAL INVESTIGATION
WORK PLAN

PREPARED FOR:

ORMET CORPORATION
HANNIBAL, OHIO

JUNE, 1987

REVISED: SEPTEMBER, 1987

REVISED: DECEMBER, 1987

REVISED: JANUARY, 1988

 GERAGHTY
& MILLER, INC.
Ground-Water Consultants

GERAGHTY & MILLER, INC.

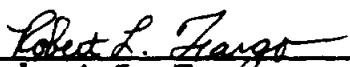
PHASE I WORK PLAN
REMEDIAL INVESTIGATION


PREPARED FOR:
ORMET CORPORATION
HANNIBAL, OHIO

REVISION 3
DECEMBER 11, 1987

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RECEIVED
DECEMBER 11 1987
G&M DIVISION
HANNIBAL, OHIO

KEMRON ENVIRONMENTAL SERVICES

GERAGHTY & MILLER PROJECT
SAMPLE LOG SHEET
GROUND-WATER - LIST A

Sample Source: _____

Analysis/Type/Volume/Preservative:

A. General Parameters	Number of Bottles
1. Polyethylene/250 ml/4° C Specific Conductance	1
2. Polyethylene/250 ml 4° C Silica	2
3. Glass/40 ml/H ₂ SO ₄ - pH < 2 TOC	1
4. Polyethylene/1000 ml/N ₂ OH/Ascorbic Acid/4° C Cyanide Total, Cyanide, Amenable to Chlorination	2
5. Polyethylene/1000 ml/H ₂ SO ₄ - pH < 2 Ammonia	1
6. Polyethylene/1000 ml/4° C Alkalinity, TDS, Chloride, Sulfate, Fluoride	2
7. Glass/40 ml/4° C pH	1
B. Dissolved Metals	
Polyethylene/1000 ml/HNO ₃ - pH < 2 Aluminum, Arsenic, Barium, Cadmium, Calcium, Chromium, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Selenium, Sodium, Zinc, Potassium, Copper, Cobalt	1

NOTE: Please fill containers with sample; complete each label with information identifying Sample Source, Date and Time Collected; repack sample kit carefully; do not pack glass against glass.

Packed By: _____	Date/Time: _____
Received By: _____	Date/Time: _____
Inspected By: _____	Date/Time: _____
Seal Intact? _____	
Sampled By: _____	Date/Time: _____

KEMRON ENVIRONMENTAL SERVICES

GERAGHTY & MILLER PROJECT
SAMPLE LOG SHEET
GROUND-WATER - LIST B

Sample Source: _____

Analysis/Type/Volume/Preservative:

	Number of Bottles
A. General Parameters	
1. Polyethylene/250 ml/4° C Specific Conductance	1
2. Polyethylene/250 ml/4° C Silica	2
3. Glass/40 ml/H ₂ SO ₄ - pH < 2 TOC	1
4. Polyethylene/1000 ml/N ₂ OH/Ascorbic Acid/4° C Cyanide Total, Cyanide, Amenable to Chlorination	2
5. Polyethylene/1000 ml/H ₂ SO ₄ - pH < 2 Ammonia	1
6. Polyethylene/1000 ml/4° C Alkalinity, TDS, Chloride, Sulfate, Fluoride	2
7. Glass/40 ml/4° C pH	1
B. Dissolved Metals	
Polyethylene/1000 ml/HNO ₃ - pH < 2 Aluminum, Arsenic, Barium, Cadmium, Calcium, Chromium, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Selenium, Sodium, Zinc, Potassium, Copper, Cobalt, Antimony, Beryllium, Silver, Thallium, Tin, Vanadium	1
C. Purgeable Organics (624)/VOA Glass/40 ml/4° C	2
D. Acid/Base Neutral (625)/Extractables Glass/1000 ml/4° C	2
E. PCB/Glass/100° ml/4° C	2

NOTE: Please fill containers with sample; complete each label with information identifying Sample Source, Date and Time Collected; repack sample kit carefully; do not pack glass against glass.

Packed By: _____	Date/Time: _____
Received By: _____	Date/Time: _____
Inspected By: _____	Date/Time: _____
Seal Intact? _____	
Sampled By: _____	Date/Time: _____

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JOANN BACK ON SEPT. 14, LEAVING ON THURSDAY

CONF. CALL \Rightarrow JOANN'D. CLEAN-UP GOALS = SUBJECT 9/1/92

5 CARCINOGENS PRESENT IN GROUND H_2O RIGHT NOW

- ESTABLISHED THE SCENARIOS, \therefore ADD CHEMICALS INTO LIST OF CARCINOGENS & CALCULATE THE CLEAN-UP GOAL
- U.S. EPA REGION II POLICY SAYS TO USE SLOPE FACTORS FOR BLOP
- MCL FOR BLOP = $2E4$ M8/R; 200 PPM
- MCL ARE NOT TOTALLY RISK-BASED
- BASED ON EXPOSURE FACTORS IN BRA & ~~EXPOS~~ TOXICITY FACTORS FROM BRA
- NEW SLOPE FACTOR FOR BLOP
- NAPHTHALENE IS A CARCINOGEN

SPECIFIC COMMENTS:

- CLEAN-UP GOAL CALCULATED FOR CHEMICAL ~~SPECIFIC~~ + PATHWAY TO GET $\frac{1}{1}$ CLEAN-UP GOAL
- ORMET ONLY CALCULATED BY CHEMICALS & PATHWAY SEPARATELY, ORMET NEVER ADDED

eg. FL

- HOW MUCH IN SOIL = ?
- HOW MUCH FL GOING INTO GROUND H_2O = ?

* OUTSIDE
SEDIMENT DON'T WORRY ABOUT ECO, ONLY WORRY ABOUT HUMAN-HEALTH
* FOR BACKWATER AREA CALCULATE CLEAN-UP GOALS FOR SEDIMENT FOR ECO (ENVIRONMENT)

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**PHASE I REMEDIAL INVESTIGATION
WORK PLAN**

INTRODUCTION

PHASE I WORK PLAN
REMEDIAL INVESTIGATION
ORMET CORPORATION
HANNIBAL, OHIO

INTRODUCTION

The United States Environmental Protection Agency (USEPA), the Ohio Environmental Protection Agency (OEPA) and Ormet Corporation (ORMET) have agreed to an Administrative Order by Consent (Consent Order) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 wherein Ormet is required, among other things, to conduct a remedial investigation (RI) to determine the nature and extent of any release or threatened release of hazardous substances, pollutants or contaminants from the Ormet facility at Hannibal, Ohio. The effective date of the Order is May 19, 1987.

Incorporated as part of the Consent Order is a Statement of Work (SOW) which outlines the tasks to be performed in conducting the RI and a subsequent feasibility study (FS) to identify and

evaluate alternatives for the appropriate extent of remedial action, if any, to prevent or mitigate the migration of any release or threatened release from the facility of hazardous substances, or of any pollutant or contaminant which may present an imminent and substantial danger to the public health or welfare.

The "Description of Current Situation" (Task 1) which is part of the Phase I Work Plan, is based upon extensive site-specific information gained through a series of hydrogeologic investigations performed at the Ormet facility. The Phase I Work Plan (Task 2) and Phase I Site Investigation (Task 3) are based upon USEPA's "Guidance on Remedial Investigations" under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, the above referenced site-specific information and upon the experience gained by Geraghty & Miller, Inc. (G&M) in the development of other approved RI/FS work plans.

G&M is the consulting firm selected by Ormet and approved by USEPA and OEPA to direct and supervise all work to be performed pursuant to the Consent Order.

1.0 DESCRIPTION OF CURRENT SITUATION (SOW TASK 1)**1.1 SITE DESCRIPTION (SOW TASK 1-A)****1.1.1 Site Physiography and Geology**

The Ormet facility in Monroe County, Ohio is situated along the west bank of the Ohio River, approximately 35 miles south of Wheeling, West Virginia. This corresponds to river mile 123.4, which is the distance downriver from the origin of the Ohio River in Pittsburgh, Pennsylvania. The facility occupies the northeastern portion of the area known as Buck Hill Bottom, a lens-shaped stretch of land approximately 2.5 miles long and up to 0.5 miles wide (see Figure 1.1-1). The Ormet property is bounded on the northwest by Ohio State Route 7 and on the east and southeast by the Ohio River. To the southwest, the site is bordered by the Consolidated Aluminum Corporation (CAC) facility, which occupies the southwestern portion of Buck Hill Bottom.

The Ormet facility is situated in the Appalachian Plateau physiographic province and is underlain by Paleozoic-age sedimentary rocks consisting mainly of conglomerates, sandstones, siltstones, shales, fresh-water and marine limestones, and coals, and lesser amounts of chert, iron ore, and rock salt or other evaporites. In hilly, more elevated parts of the region, rock units are generally overlain by a thin to moderately thick layer of sedentary or residual soil that has been formed in place by the

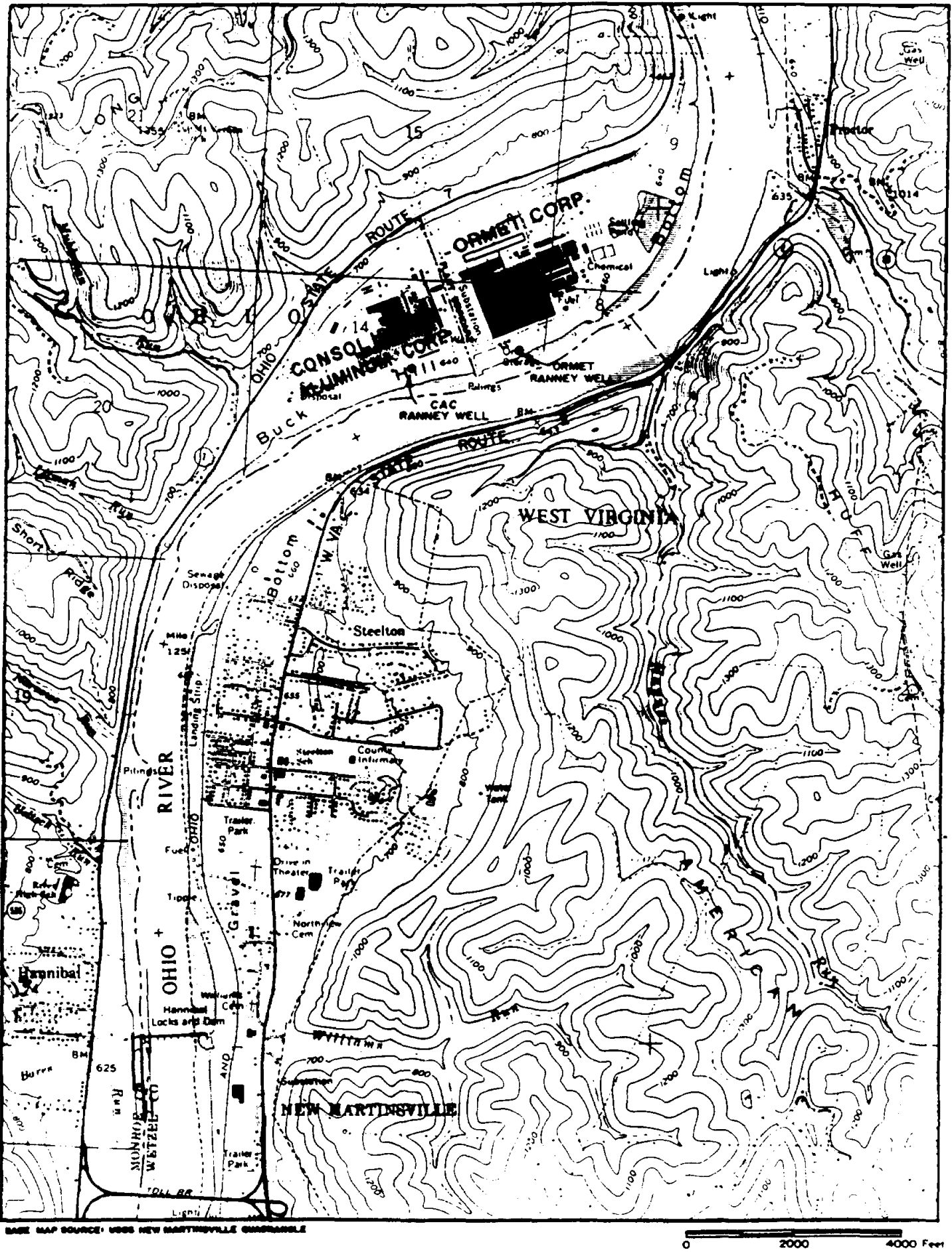


FIGURE 1.1-1 General location of Ormet Corporation plant site.

Ormet Corporation

disintegration of underlying rocks and by the accumulation of organic material. These soils are usually relatively fertile and well drained and are capable of supporting woodland, cropland, and pasture.

In areas adjacent to the Ohio River, steep valley walls with outcropping rocks of Pennsylvanian- and Permian-age descend to relatively flat-lying bottomland deposits characterized by flood-plain and river-terrace features. River terraces beneath mid and upper portions of Buck Hill Bottom are thought to represent Pleistocene-age glacial outwash (i.e., sand and gravel) deposited as the glaciers retreated (i.e., melted) and that has been carved into a stepped profile by the downcutting Ohio River. These sand and gravel deposits are fairly continuous down to bedrock, at a depth ranging from 50 to 100 feet below land surface. Along the edges of the valley (i.e., adjacent to the valley wall) these outwash deposits generally are capped by colluvium (clay, silt, and rock fragments) derived from weathering and mass wasting of highlands and the valley wall.

Beneath the areas of the facility near the river, sand and gravel deposits are generally overlain by deposits of silt and

clay, which form a wedge that thickens toward the river. These near-river deposits represent glacial-age flood plains deposited by the river during past regimens. Such deposits tend to contain greater quantities of silt and clay.

Geologic cross-sections depicting the alluvial deposits beneath the Ormet facility were prepared as part of a hydrogeologic investigation performed by G&M in 1983/84 and are presented in the report attached as Appendix A. Geologic cross-sections were further refined following a supplemental study conducted by G&M in 1986 and are provided in Appendix B.

In the area of the Ormet plant, two main terrace levels are present, with lower and upper terrace elevations averaging about 630 and 665 feet above mean sea level, respectively. The main plant facilities are located on the upper terrace, which is bounded to the northwest by Ohio State Route 7. The lower terrace consists of a relatively narrow strip of land that is bounded by the Ohio River. The Ohio River pool elevation in this area ranges from 620 to 624 feet above mean sea level and, as a result of the Hannibal Lock and Dam, tends to remain fairly constant throughout high-and low-flow periods.

1.1.2 Site Hydrology and Hydrogeology

Two types of water-bearing zones are present within the alluvial deposits beneath the Ormet plant site: 1) discontinuous zones of perched ground water, and 2) the Ohio River Valley alluvial aquifer. The perched zones appear to be limited vertically and laterally, and are believed to represent mainly infiltration-type recharge that accumulates (possibly intermittently) on top of unconsolidated deposits/layers having somewhat lower permeability than the overlying sediments.

The Ohio River alluvial aquifer is composed primarily of the sand and gravel outwash deposits, and constitutes the main water-bearing unit in the area. This aquifer is currently utilized within the Buck Hill Bottom area, and is producing about four million gallons of water daily, most of which is being pumped from two Ranney wells; one at the Ormet facility and the other at the CAC plant (see Figure 1.1-1). Approximately one million gallons of the water is used as potable water by Ormet and CAC employees. From 2 to 2.5 million gallons is used in the Ormet reduction process, primarily as contact and non-contact cooling water. From .6 to .8 million gallons is pumped from the interceptor wells and is not used prior to discharge through an Ormet outfall.

Based on aquifer pumping tests performed during early studies (Klaer, February, 1973), aquifer sediments typical of the central

plant area are characterized by a coefficient of transmissivity of about 60,000 gpd/ft and a coefficient of permeability of about 1,900 gpd/ft² (or a hydraulic conductivity of about 10⁻¹ cm/sec). The coefficient of storage is calculated to be about 0.19 (dimensionless). Using these data, G&M estimates that ground water beneath the plant is moving toward the Ormet Ranney well at a rate of about 9 to 10 feet per day (3300 to 3700 feet per year) under the hydraulic gradients typically observed.

Prior to the development of the aquifer, (i.e., the installation of the Ranney Wells and subsequent pumping of ground water) the water table probably sloped from north to south, with ground water flowing toward and discharging into the Ohio River. Pumping from the Ranney wells has caused the water table to drop below the level of the river. As a result, water is now being pulled from the river into the aquifer, and is flowing in the direction of the pumping centers. Ground-water withdrawals by the Ranney wells have created two large cones of influence which converge to form a gently rounded ground-water divide that is situated roughly parallel and to the south of Ormet's southwest property boundary.

A ground-water divide is a hydraulically high point, or ridge, in the surface of the water table. A ground-water divide creates a hydraulic barrier, such that ground water on one side of the divide

flows away from it in one direction, while ground water on the other side flows away in another direction. In this case, ground water on the west/southwest side of the divide is drawn toward to CAC Ranney well, while ground water on the east/northeast side is drawn toward the Ormet Ranney well. Water-table contour maps depicting typical past and recent flow patterns are given in Figures 1.1-2 and 1.1-3.

The completion of the Hannibal Lock and Dam in 1973 caused roughly a 20-foot rise in the river-pool elevation. Aside from an overall rise in ground-water levels of some 5 to 10 feet, the rise in the pool elevation does not appear to have substantively changed the configuration of the water table under pumping conditions.

Under present pumping conditions, the aquifer is receiving recharge primarily from the Ohio River, with lesser contributions from infiltrating precipitation and from the adjacent/subjacent bedrock system. As a result of current pumpage, water flows from the river into the aquifer and there is no apparent natural discharge of ground water to the river along the Ormet river/plant boundary. A more thorough discussion of the hydrogeology at the site is presented in Appendix A of this workplan.

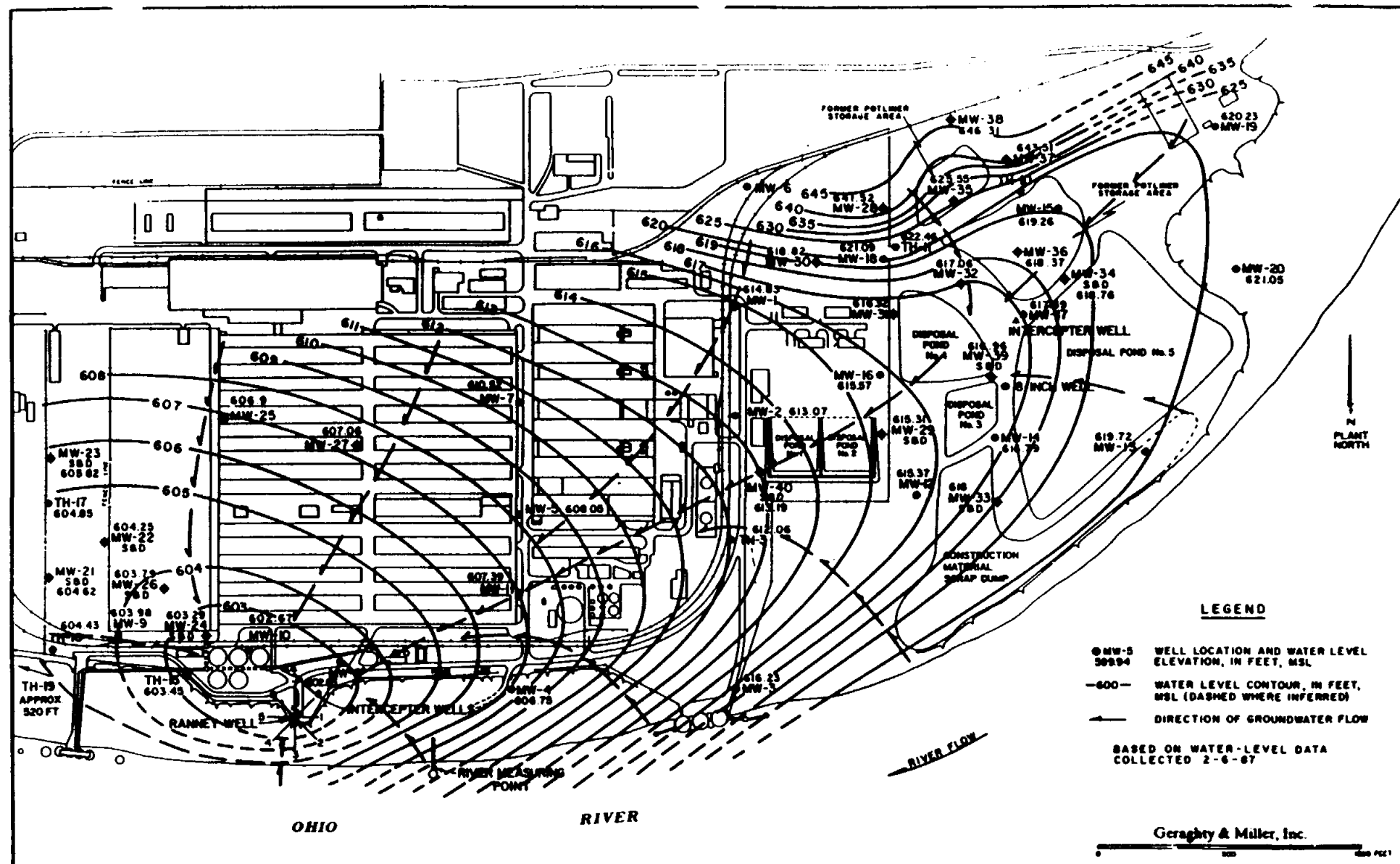


FIGURE 1.1-2 Inferred ground-water contour map depicting conditions at the Ormet Corporation plant site as determined by water-level data collected February 6, 1987.

Ormet Corporation
Hannibal, Ohio

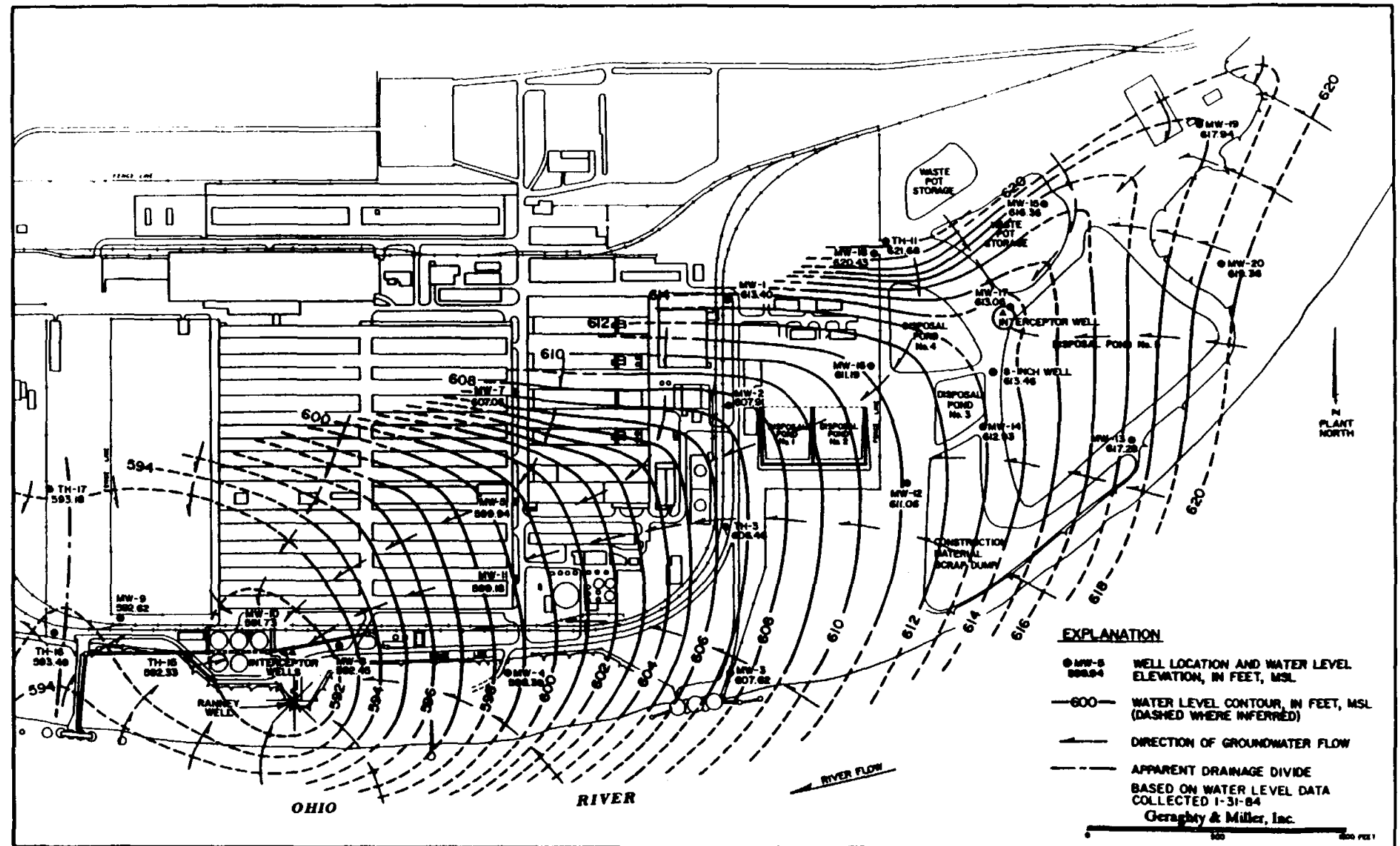


FIGURE 1.1-3 Inferred water-table contour map depicting conditions at the Ormet Corporation plant site as determined by the 1983/1984 Geraghty & Miller study

Ormet Corporation
Hannibal, Ohio

1.1.3 Site Ecology

The area around the Ormet facility is characterized by a temperate continental climate with warm summers and cold winters averaging about 73°F and 34°F, respectively; the mean annual temperature for the area is about 54°F (Soil Conservation Service, 1960). Precipitation is ample and fairly well distributed throughout the year with average precipitation on the order of 44 inches.

A variety of vegetation grows within and in the immediate vicinity of the study area. Deciduous tree species predominate within the study area and include maples, wild cherry, locust, dogwood, various types of oak, sumac, and others. Several small stands of pine trees are also present. Throughout the study area, a variety of indigenous weed and grass species exist.

A number of types of birds and animals are also found within the study area. Among the bird species present are great blue herons, vultures, kill deer, doves, crows, seagulls and a variety of common smaller birds such as sparrows, starlings, robins, etc. Both large and small mammals occur near the facility, including white-tailed deer, groundhogs, racoons, rabbits, squirrels, opossums, skunks, chipmunks, and other rodents. Along portions of the Ohio River and its tributaries, muskrats are not uncommon.

In the river itself, common fish species include carp, catfish, bass, shad, and other common river species. We are not aware of any designated critical habitat in the area of the site.

1.1.4 History of On-Site Waste Treatment, Storage, and Disposal

1.1.4.1 Spent Potliner Storage and Treatment

Since beginning plant operations in 1958, Ormet's main process has been the reduction of alumina to produce aluminum metal by the Hall-Herault process. In this process, alumina is placed in an electrolytic bath contained in a series of electrolytic cells, or pots, and is reduced to aluminum. The pots are lined with prebaked blocks of a mixture of anthracite and pitch which are joined with a small amount of similar material and baked in situ. This potliner eventually deteriorates to a point at which it must be removed and the cell is relined.

It is estimated that, from 1958 to 1968, approximately 85,000 tons of spent potliner material was placed in an unlined open storage area located in the northeast portion of the Ormet property. From 1968 to 1981, Ormet operated a cryolite-recovery process which utilized caustic digestion to recover cryolite from the spent potliner. When the cryolite-recovery plant was put into operation, heavy equipment was used to load the potliner from the open storage area into trucks for transport to the cryolite-recovery

plant. Through utilization of the cryolite-recovery process, the stockpiles of spent potliner material in the former storage area were eliminated. Since the shutdown of the cryolite-recovery plant in the fall of 1981, all spent potliner has been transported off-site for disposal. Since 1980, interim accumulation of spent potliner material has been under cover on a concrete pad.

1.1.4.2 Retention Ponds

At various times from 1958 to 1981, Ormet utilized one or more of the five retention ponds (Ponds 1 through 5) located in the northeastern portion of the facility. These ponds were constructed of natural materials and did not include synthetic liners. When in use, Ponds 1 through 4 received sludge from the pot room wet scrubbing system. The primary constituents of this sludge were alumina, particle carbon, and calcium-based salts. Pond 5 was put into service to receive tailings from the cryolite-recovery plant when it began operation in 1968. These alkaline cryolite tailings consist primarily of carbonaceous material from the potliner after it has been treated by the caustic digestion process in the cryolite plant. In addition to particle carbon and alumina, these alkaline cryolite tailings contained sodium-based salts, as well as some calcium salts. Each pond is surrounded by a dike that consists of an undetermined mixture of clay, soil, and rock. The composition of these dikes will be further characterized by soil boring activities to be conducted during the Phase I RI.

1.4 FACILITY INSPECTION (SOW TASK 1-D)

Since the fall of 1983, Geraghty & Miller, Inc. has been retained by Ormet Corporation to study hydrogeologic conditions at its Hannibal facility. Since the onset of this work, G&M has become very familiar with site features including topography, access routes, accessibility, and proximity of ground-water users. G&M has also accompanied USEPA and OEPA representatives on several on-site inspections of the facility.

Through site-specific investigations, G&M has gained a comprehensive understanding of site geology, ground-water flow, ground-water recharge/discharge mechanisms, known and suspected source areas, water-quality trends, plume migration trends, approximate plume boundaries, factors controlling ground-water flow and plume migration, the position of ground-water divides, and other site conditions. These investigations have provided the information needed to prepare the site Health and Safety Plan, which is included as Section 4.0.

1.5 BOUNDARY CONDITIONS (SOW TASK 1-E)

A chain-link fence is currently in place which separates the Ormet plant proper from suspected source areas situated within the northeast portion of Ormet property. The fence, in conjunction with a locked cable-type gate to the far northeast of the property, restricts vehicle accessibility to the portion of Ormet property where dominant source areas are thought to exist. Also, these boundaries are regularly patrolled by plant security personnel. Boundaries and other plant features limiting accessibility shall be shown in greater detail on the expanded site map that is to be prepared as part of the Phase I RI Work Plan.

1.6 SITE MAP (SOW TASK 1-F)

A site topographic map of the Ormet facility using a contour interval of 1-foot and a horizontal scale of one inch to fifty feet, has been completed and will be used to report data generated during this RI. The map is based upon aerial surveys (i.e., fly-overs) made during April, 1987.

1.7 ADDITIONAL DATA (SOW TASK 1-G)

In preparing for and in performing the site hydrogeologic investigations at the Ormet facility, G&M has routinely collected and reviewed known available background information. These background data, usually general in nature, are of limited usefulness in developing and conducting the Phase I RI Work Plan, in light of the substantial amount of site-specific work performed at the Ormet facility by G&M (Appendix A and Appendix B).

In conjunction with the performance of the Phase I RI, G&M has obtained copies of the reports of annual site inspections conducted by OEPA and/or USEPA since 1980. Also, Ormet had requested, and received on July 22, 1987. A copy of the "Aerial Photographic Analysis of a Waste Disposal Site-Hannibal, Ohio", published by the U.S. EPA Environmental Monitoring Systems Laboratory.

Ponds 1 through 4 are about one acre or less in size and probably from six to eight feet deep. Pond 5 is approximately eight acres in area and probably ranges from fifteen to twenty or more feet in depth. The combined volume of material contained in the five ponds is estimated to be on the order of 300,000 cubic yards.

1.1.4.3 Construction Materials Scrap Disposal

From time to time prior to 1980 Ormet deposited waste construction materials and other miscellaneous scrap in the southeastern corner of the Ormet property. This area is depicted on Figure 1.2-1. No material has been deposited in the scrap dump since 1979.

1.1.4.4 Carbon Runoff Deposition Area

Directly west of the construction materials scrap dump there is a low-lying area where carbon materials have accumulated. These carbon materials have probably been carried to this area by storm-water during periods of heavy rain (see Figure 2.7-1).

1.2 NATURE AND EXTENT OF PROBLEM

1.2.1 Description of Existing Ground-Water Condition

Past studies have identified two potential sources of ground-water contamination at the Ormet site: residual potliner material that is disseminated and/or interlayered in the surficial soils in the former potliner storage area, and retention pond materials.

1.2.1.1 Former Potliner Storage Area

When the cryolite recovery plant was put into operation in 1968, potliner material from the open storage area was transported to that facility for processing, eliminating the stockpiles of material in the former storage area. However, considering the nature of the operation (i.e., use of heavy equipment) it is likely that some portion of the potliner material was broken and crushed and became mixed with the underlying soils.

Because the residual potliner material is intermixed and/or interlayered in the shallow soil, it is virtually impossible to arrive at an accurate estimate of the volume of actual potliner

material that may still be present within the former storage area. Surface geophysical surveys and a subsequent soil boring and analysis program were performed as part of G&M's Supplemental Hydrogeologic Investigation initiated in 1986. It is estimated that the area of soil which may contain residual potliner is on the order of 10 acres. Soil conductivity contour maps constructed from the results of electromagnetic terrain conductivity surveys, soil boring logs, and the results of subsequent soils analyses are included in Appendix B. Additional studies to characterize soil and source materials in the former potliner storage area are included in the Phase I RI Work Plan.

1.2.1.2 Decommissioned Retention Ponds

As indicated previously (Section 1.1.4.2), Ponds 1 through 4 contain sludge from a wet air emission control system which was replaced by a new, state-of-the-art dry air emission control system in 1979. The primary constituents of the sludge are alumina, particle carbon, and calcium-based salts. Pond 5 contains cryolite recovery plant tailings containing carbonaceous material, alumina, sodium-based salts and some calcium-based salts. The combined volume of the material contained in Ponds 1 through 4 is approximately 50,000 cubic yards and the volume of material in Pond 5 is approximately 250,000 cubic yards.

As part of the 1986 study, G&M conducted a pond solids sampling and analysis program to characterize the chemical composition of the material in the ponds and to develop a "fingerprint" that could be used to distinguish pond-related effects in the ground water from potliner-related effects. The sampling program revealed that the upper two to four feet of material in the ponds is a dry, dark grey to black, silt-size material, which has begun to support the growth of patches of sparse vegetation. Below two to four feet the consistency changes to saturated ooze solids. Solids samples were collected from depths of 3 to 4 feet at the approximate locations shown in Figure 1.2-1 and were composited for each pond. For Pond 5, two composites were prepared. The results of laboratory analyses conducted on these composites are provided in Table 1.2-1. In addition, pond solids analytical data from Attachment 6 of U.S. EPA's NPDES Compliance Sampling Inspection Report (October 31, 1984) are given in Table 1.2-1a.

Early hydrogeologic investigations (Klaer, September, 1972) at the Ormet facility indicated that fluid was mounding to form a locally elevated ground-water surface beneath Pond 5 (then in service) and that affected ground water was emanating from beneath both the potliner storage area and Pond 5. A supplemental study (Dames and Moore, 1978) demonstrated an improvement in the quality

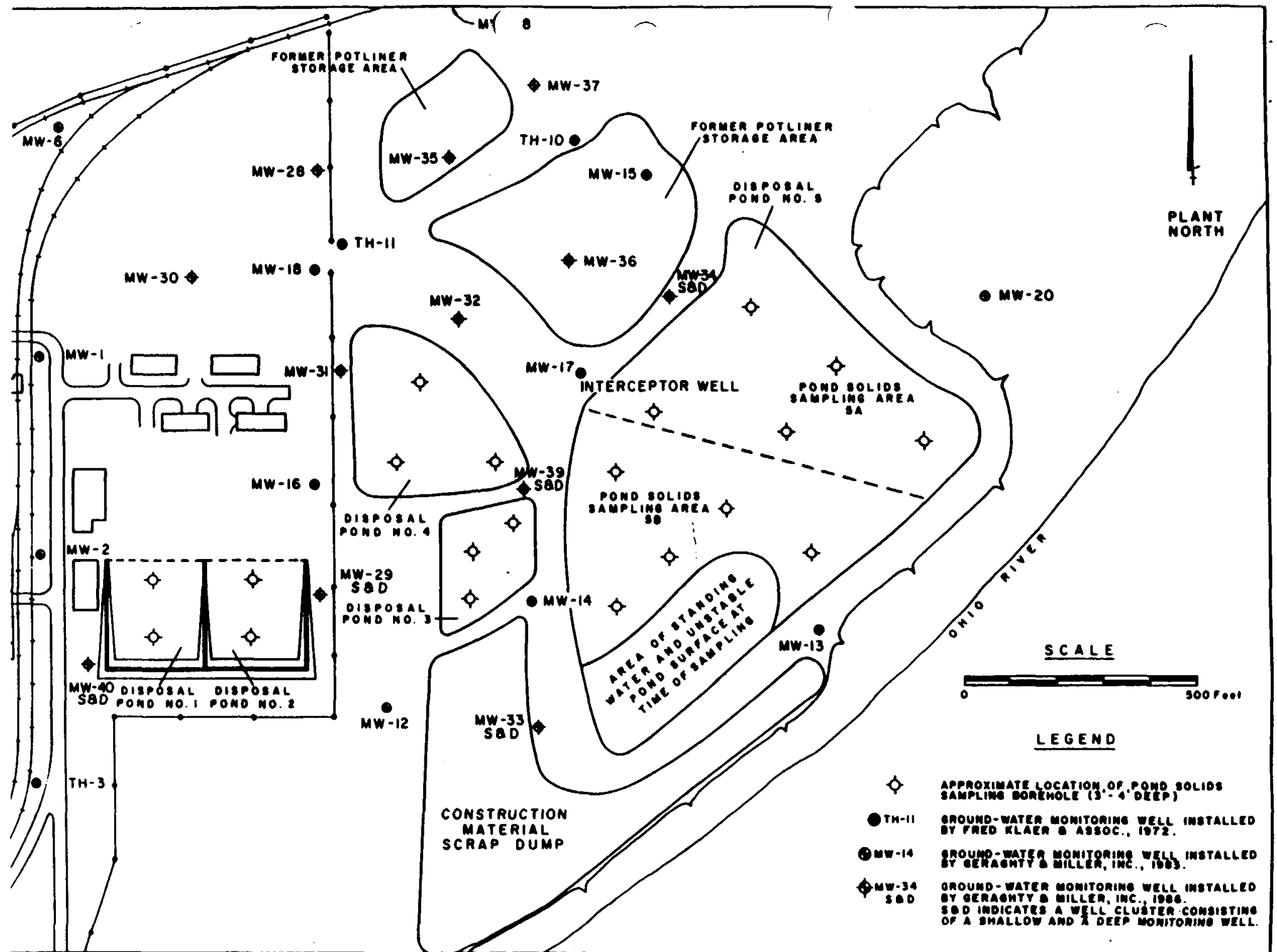


TABLE 1.2-1

RESULTS OF POND SL SAMPLE ANALYSES
RESULTS IN MG/KG UNLESS OTHERSIDE STATED

Parameter	Method	Pond 1 & 2 Composite	Pond 3 Composite	Pond 4 Composite	Pond 5 Composite A	Pond 5 Composite B
Alkalinity (as CaCO ₃)	EPA 310.1	10700	1150	850	10550	6250
Aluminum, Total	EPA 202.1	56300	47200	53500	82000	64800
Ammonia Nitrogen	EPA 350.2	30	<10	50	<10	50
Barium, Total	EPA 208.1	<50	<50	<50	<50	<50
Beryllium, Total	EPA 210.1	<5	<5	<5	14	15
Cadmium, Total	EPA 213.1	<1	<1	<1	<1	<1
Calcium, Total	EPA 215.1	13700	33900	32600	12900	19300
Chloride	EPA 325.3	<10	<10	<10	<10	<10
Chromium, Total	EPA 218.1	30	98	82	21	25
Chromium, Hexavalent	EPA 218.4	<1	<1	<1	<1	<1
Cobalt, Total	EPA 219.1	5	12	13	2	5
Conductance, mhos/cm	EPA 120.1	29200	24500	20000	22300	14100
Copper, Total	EPA 220.1	84	110	68	24	25
Cyanide, Total	EPA 335.3	30	20	10	185	288
Cyanide, Free	EPA 335.1	9	<1	<1	14	9
Fluoride	EPA 340.2	22	14	17	14	10
Iron, Total	EPA 236.1	6310	9930	9940	4400	4610
Lead, Total	EPA 239.1	40	149	239	13	13
Magnesium, Total	EPA 242.1	1630	1090	1480	1440	2190
Nickel, Total	EPA 249.1	132	362	361	26	32
Potassium	EPA 258.1	300	180	200	380	640
Silicon (as SiO ₂)	EPA 370.1	3000	9100	18000	2300	3500
Zinc, Total	EPA 289.1	17	20	18	19	62
Sodium	EPA 273.1	15000	13400	9400	12800	7300
Total Solids, %		56.2	44.8	45.2	59.0	50.0
Acid Compounds						
Method: EPA 8040						
Phenol		<1	<1	<1	<1	<1
2-Chlorophenol		<1	<1	<1	<1	<1
2-Nitrophenol		<2	<2	<2	<2	<2
2,4-Dimethylphenol		<1	<1	<1	<1	<1
2,4-Dichlorophenol		<1	<1	<1	<1	<1
4-Chloro-3-methylphenol		<1	<1	<1	<1	<1
2,4,6-Trichlorophenol		<1	<1	<1	<1	<1
2,4-Dinitrophenol		<5	<5	<5	<5	<5
4-Nitrophenol		<1	<1	<1	<1	<1
2-Methyl-4,6-dinitrophenol		<5	<5	<5	<5	<5
Pentachlorophenol		<2	<2	<2	<2	<2

Base/Neutral Compounds
Method: EPA 8250

TABLE 1.2-1 (continued)

	is 1 & 2 Composite	Pond 3 Composite	Pond 4 Composite	Pond 5 Composite A	Po. Composite B
N-Nitrosodimethylamine	<0.2	<0.2	<0.2	<0.2	<0.2
Bis (2-Chloroethyl) Ether	<0.1	<0.1	<0.1	<0.1	<0.1
1,3-Dichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
1,4-Dichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
Bis (2-Chloroisopropyl) Ether	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
N-Nitroso-Di-n-Propylamine	<0.2	<0.2	<0.2	<0.2	<0.2
Nitrobenzene	<0.2	<0.2	<0.2	<0.2	<0.2
Isophorone	<0.1	<0.1	<0.1	<0.1	<0.1
Bis (2-Chloroethoxy) Methane	<0.1	<0.1	<0.1	<0.1	<0.1
1,2,4-Trichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	2.1	<0.1	<0.1	0.71	0.35
Hexachlorobutadiene	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorocyclopentadiene	<0.2	<0.2	<0.2	<0.2	<0.2
2-Chloronaphthalene	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.22	<0.1	0.31	<0.1	<0.1
Dimethyl Phthalate	<0.1	<0.1	<0.1	<0.1	<0.1
2,6-Dinitrotoluene	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.48	<0.1	<0.1	0.73	0.48
2,4-Dinitrotoluene	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	0.29	<0.1	1.3	<0.1	<0.1
Diethyl Phthalate	<0.1	<0.1	<0.1	0.24	<0.1
4-Chlorophenyl Phenyl Ether	<0.1	<0.1	<0.1	<0.1	<0.1
N-Nitrosodiphenylamine	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Diphenylhydrazine	<0.1	<0.1	<0.1	<0.1	<0.1
4-Bromophenyl Phenyl Ether	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorobenzene	<0.2	<0.2	<0.2	<0.2	<0.2
Phenanthrene	36	34	70	11	8.6
Anthracene	4.0	2.3	19	2.4	2.1
Di-n-Butyl Phthalate	0.46	0.23	0.50	0.96	0.39
Fluoranthene	35	57	<0.1	13	12
Benzidine	<1	<1	<1	<1	<1
Pyrene	24	38	<0.1	9.9	9.1
Butyl Benzyl Phthalate	0.71	<0.1	4.2	<0.1	<0.1
Benzo(a)Anthracene	18	19	65	6.5	6.1
3,3-Dichlorobenzidine	<0.2	<0.2	<0.2	<0.2	<0.2
Chrysene	18	26	110	7.1	6.3
Bis (2-Ethylhexyl) Phthalate	31	<1	<1	2.9	3.1
Di-n-Octyl Phthalate	2.1	<0.1	<0.1	<0.1	<0.1
Benzo (a) Pyrene	12	4.3	68	4.9	4.8
Indeno(1,2,3-cd)Pyrene	5.9	3.1	29	3.7	3.6
Dibenzo(a,h)Anthracene	3.7	1.4	13	1.4	1.3
Benzo(g,h,i)Perylene	4.6	2.6	25	3.4	3.3
Benzo(b+k)Fluoranthene	25	22	110	9.4	9.2

TABLE 1.2-1 (Continued)

Volatile Organic Compounds Method: EPA 8010,8020,8030	Ponds 1 & 2 Composite	Pond 3 Composite	Pond 4 Composite	Pond 5 Composite A	Pond 5 Composite B
Benzene	<10	<10	<10	<10	<10
Carbon Tetrachloride	<1	<1	<1	<1	<1
Chlorobenzene	<1	<1	<1	<1	<1
1,2-Dichloroethane	<1	<1	<1	<1	<1
1,1,1-Trichloroethane	<1	<1	<1	<1	<1
1,1-Dichloroethane	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	<1	<1	<1	<1	<1
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	<1
Chloroethane	<10	<10	<10	<10	<10
2-Chloroethyl Vinyl Ether	<10	<10	<10	<10	<10
Chloroform	<1	<1	<1	<1	<1
1,1-Dichloroethylene	<1	<1	<1	<1	<1
1,2-Trans-Dichloroethylene	<1	<1	<1	<1	<1
1,2-Dichloropropane	<1	<1	<1	<1	<1
1,3-Dichloropropylene	<1	<1	<1	<1	<1
Ethylbenzene	<1	<1	<1	<1	<1
Methylene Chloride	<1	<1	<1	<1	<1
Methyl Chloride	<5	<5	<5	<5	<5
Methyl Bromide	<5	<5	<5	<5	<5
Bromoform	<1	<1	<1	<1	<1
Dichlorobromomethane	<1	<1	<1	<1	<1
Chlorodibromomethane	<1	<1	<1	<1	<1
Tetrachloroethylene	<1	<1	<1	<1	<1
Toluene	<1	<1	<1	<1	<1
Trichloroethylene	<1	<1	<1	<1	<1
Vinyl Chloride	<10	<10	<10	<10	<10

TABLE 1.2-1a

RESULTS OF LABORATORY ANALYSES PERFORMED ON
SOLIDS SAMPLE COLLECTED FROM POND 5 DURING
U.S. EPA NPDES COMPLIANCE SAMPLING INSPECTION
JUNE 26-27, 1984

phenolics	1.0 mg/kg
cyanide (total)	120 mg/kg
phenanthrene	13 mg/kg
anthracene	10 mg/kg
fluoranthene	12 mg/kg
pyrene	12 mg/kg
crysene	8.4 mg/kg
benzo (a) anthracene	9.0 mg/kg
benzo (a) pyrene	160 mg/kg

of ground water in the vicinity of Pond 5. In 1983 and 1984 a detailed hydrogeologic investigation was conducted at the Ormet facility by G&M. The results of this work (see Appendix A) confirmed improvements in ground-water-quality in the vicinity of Pond 5.

Based upon its studies, G&M has determined that there is a well-defined plume of ground water beneath the Ormet plant site characterized by elevated levels of fluoride, cyanide, sodium, and ammonia, and high pH. Currently, the most concentrated portion of this plume, as identified by water-quality data from monitoring wells MW-2, MW-18 MW-32, MW-35, and MW-37 (the most affected wells at the site), extends from beneath the former potliner storage area, southwestward toward the Ormet Ranney well. This plume is being effectively contained by a system of interceptor wells and the Ormet Ranney well*.

* The Ormet Ranney well generally is pumped at a rate of 1500 to 1900 gallons per minute, the old interceptor from 300 to 400 gpm, the new interceptor between 130 and 175 gpm and the CAC Ranney well from 500 to 900 gpm.

A supplemental ground-water sampling and analysis program was performed by Geraghty and Miller, Inc. in October, 1985 did not detect any ground-water contamination by organic compounds, with the exception of trace levels of toluene (9-15 ppb). This program included sampling and analysis of monitoring wells MW-2, MW-5, MW-16, MW-17, MW-18, as well as the 004 outfall and the old interceptor well. In addition to a lengthy list of common water quality parameters and cations and anions, the samples were analyzed for organic compounds of the Priority Pollutant List. The base neutral compounds were analyzed using a GC/MS scan according to EPA 8040, while the acid extractable compounds were analyzed by GC scan following EPA 8250. The volatile organic compounds were analyzed according to EPA 601/602, using a Hall Detector for the halogenated compounds and a FID for the non-halogenated compounds. The results of this ground-water sampling and analysis program are provided in Appendix C-3.

Considering the above-mentioned data, it is the opinion of G&M that the residual potliner is a primary cause of current ground-water contamination at the Ormet facility, as evidenced by the pH and by the concentrations of indicator parameters such as fluoride, sodium, cyanide, and ammonia characterizing ground water beneath and immediately downgradient from the former potliner storage area.

Notwithstanding G&M's interpretations of the existing data with regard to main source areas at the site, substantial additional work to provide more data regarding the relative effects on ground water of the potential source areas (i.e., the former potliner storage area and the decommissioned retention ponds) is included in the Phase I RI Work Plan.

1.2.2. Potential Threats to Public and Environment

1.2.2.1 Ground Water

As discussed in section 1.2.1, there is a well defined plume of ground water characterized by elevated levels of fluoride, cyanide, sodium, and ammonia, and high pH contained beneath the Ormet plant site. There are no sources of community drinking water within a three-mile radius of the Ormet facility (OEPA Hazard Ranking Score, February 1985). The only potable water supply well within the three-mile area is the Ranney well on the CAC plant property which provides potable water for the approximately 2300 employees of the Ormet and CAC plants. The substantial cone of influence created by the Ormet Ranney well*

*Ormet's Ranney well is the source of the process water needs for the Ormet plant. Consequently, other than short periods of down time for maintenance and repair, the Ormet Ranney well has been operated on a continuous basis throughout the period of operations at the Ormet plant. There are no records in Ormet's files which indicate any significant shut down of the Ormet Ranney well.

creates an effective hydraulic barrier which prevents the Ormet ground-water plume from migrating beyond the Ormet property boundary toward the CAC Ranney well; therefore there is no actual threat to the CAC/Ormet potable water supply (see Section 1.1.2).

The ground-water discharge from interceptor wells on the Ormet property was, prior to the Fall of 1983, conveyed by pipe to Pond 5. In the Fall of 1983, Ormet sought and obtained the concurrence of OEPA to discharge the interceptor well water directly to the Ohio River through an outfall designated as Outfall 004 in the Ormet NPDES Permit.*

The ground-water discharge to the Ohio River through the outfall has continued since the Fall of 1983.** In May, 1987, OEPA issued a renewal NPDES Permit for the Ormet plant which imposes effluent limitations on the pollutants present in the ground-water discharge through Outfall 004. An administrative order issued in conjunction with the renewal NPDES permit allows

*The interceptor wells on the Ormet property were installed to preserve the water quality of Ormet's Ranney well. Discontinuance of the operation of Ormet's interceptor wells would pose no threat to the CAC's Ranney well because the hydraulic barrier which prevents ground water under the Ormet property from flowing to the CAC property is provided by the operation of Ormet's Ranney well; not the interceptor wells.

**At the time Ormet sought and obtained OEPA's approval to discharge the interceptor well water through Outfall 004, Ohio EPA was in the process of reviewing Ormet's application for renewal of its NPDES permit. Therefore, there were no effluent limits expressly applicable to the discharge of interceptor-well water through Outfall 004.

Ormet until March, 1989 to achieve compliance with those effluent limitations. Ormet has challenged the OEPA's basis for establishing the effluent limits applicable to the ground-water discharge, the feasibility of achieving those effluent limits, and the compliance schedule for achieving those effluent limits. Those issues are the subject of an appeal currently pending before the Environmental Board of Review of Ohio.

The levels of pollutants present in Ormet's interceptor-well water discharge are within the limit calculated by utilizing the Water-Quality Criteria for the Ohio River.

One of the purposes of the RI is to obtain additional data to assess what, if any, actual or potential threats to human health, welfare or the environment are posed by the plume of ground water which is presently contained beneath the Ormet property and which is being discharged to the Ohio River through Outfall 004.

1.2.2.2. Former Potliner Storage Area

As discussed in Section 1.2.1, the former potliner storage area is a potential source of ground water contamination. In addition, it is theoretically a potential source of airborne release of particulate matter. There is no known evidence of any airborne release of any hazardous substances from the former spent

potliner area.* However, one of the purposes of this RI is to obtain data to determine what, if any actual or potential threats to human health, welfare or the environment are posed by airborne releases of hazardous substances, if any, from the former potliner storage area.

1.2.2.3 Ponds

As discussed in Section 1.2.1, the decommissioned ponds at the Ormet site may be potential sources of ground water contamination. In addition, they are theoretically a potential source of airborne releases of particulate matter. There is no known evidence of any airborne release of any hazardous substances from the decommissioned ponds on the Ormet site.* However, one of the purposes of this RI is to obtain data to determine what, if any, actual or potential threats to human health, welfare or the environment are posed by airborne releases or hazardous substances, if any, from the decommissioned ponds.

1.2.2.4. Construction Material Scrap Dump, Carbon Runoff and Deposition Area and Recreation Area

There is no known evidence that the construction material scrap dump, the carbon runoff and deposition area, or the

* The worksheet which accompanied the OEPA Hazard Ranking Score for the Ormet site indicates no observed release of contaminants to the air, and no value was assigned for releases to the air.

recreation area present any actual or potential threats to human health, welfare, or the environment. However, one of the purposes of this RI is to obtain data to determine what, if any, actual or potential threats to human health, welfare or the environment are posed by hazardous substances, if any, which are found to be present in these areas.

1.2.3 Other Migration Pathways

The potential pathways of exposure to contaminants identified by EPA and OEPA for evaluation are:

- a. On-site ingestion of and associated direct contact with ground-water
- b. On-site inhalation of particulates from on-site soils
- c. Direct contact with on-site soils
- d. Off-site ingestion of and dermal contact with Ohio River water
- e. Off-site ingestion of ground water
- f. Off-site inhalation of particulates from on-site soils
- g. Inhalation of volatiles from ground water
- h. Inhalation of volatiles from Ohio River water
- i. Inhalation of volatiles from soils
- j. Ingestion of fish contaminated by their consumption of contaminated sediments or Ohio River water

Activities conducted during the RI will provide data that may be used to evaluate the actual or potential threat, if any, to human health and welfare that may exist from exposure to contaminants via these pathways.

1.2.4 Socioeconomic Considerations

It is premature to attempt to identify and evaluate relevant socioeconomic considerations at this time. Such considerations will be identified and evaluated to the extent necessary and appropriate following the completion of the RI.

1.3 HISTORY OF RESPONSE ACTIONS (SOW TASK 1-C)

1.3.1 Enforcement Actions

Prior to the current RI/FS being conducted under CERCLA, no response actions had been undertaken by local, state, or Federal agencies to compel private cleanup at the Ormet plant in Hannibal, Ohio. However, Ormet had retained consultants to perform a series of hydrogeologic investigations for the purpose of identifying potential sources of ground-water contamination and to develop appropriate remedial alternatives. These site activities are summarized in the following paragraphs.

1.3.2 Earlier Studies

♦ Changes in the quality of water produced by the Ormet Ranney well prompted site hydrogeologic studies (Klaer, 1972) to assess water-quality conditions and ground-water flow patterns beneath the facility. The studies included the installation of 20 monitoring wells (TH series). Resultant data indicated that fluid was mounded beneath Pond 5 and that affected ground water was being pulled from beneath the disposal ponds and potliner storage area toward the Ormet Ranney well. Interceptor Wells 1 and 2 were installed several hundred feet

north of the Ranney well to intercept the plume before it reached this pumping center.

♦ A supplemental study (Dames and Moore, 1978) demonstrated improvement in the quality of ground-water in the vicinity of Pond 5. It was also concluded that the quality of ground water beneath the potliner storage area had become slightly more contaminated than in 1972.

♦ In March, 1982, Interceptor Well 3 was installed adjacent to the northwest corner of Pond 5 in an effort to collect contaminated ground-water before it migrates toward the Ranney well.

1.3.3 Recent Studies

♦ Geraghty and Miller, Inc. was retained by Ormet in October, 1983 to conduct a detailed hydrogeologic investigation at the Hannibal facility. The purpose of the study was to better define the source(s), and the nature and extent of the ground-water contamination, and to identify possible remedial alternatives to abate existing and potential conditions. The 1983 G&M study included the installation of nineteen additional monitoring wells. It was concluded that there is no apparent natural

discharge of ground water to the Ohio River along Ormet's river/plant boundary due to the drawdown in the water table created by the pumping of the Ormet Ranney well. It was also determined that, under normal pumping conditions, plumes are contained within Ormet's facility boundaries by pumping of the Ormet Ranney and interceptor wells. Water-quality data collected during this G&M study suggested that the ground-water contamination related to Pond 5 had become greatly reduced since the 1972 study and that the existing ground-water conditions were primarily due to leachate generated from within the former potliner storage area. A detailed report of this investigation is provided in Appendix A.

♦ Following the 1983 study, G&M continued to sample, analyze, and evaluate ground water from the nineteen monitoring wells. These subsequent sampling and analysis programs were performed during September, 1984 and May, 1985. Results indicated ground-water flow patterns consistent with those previously mapped and possible slight improvements in plume quality. Water-level and water-quality data collected from this routine monitoring are provided in Appendix C.

♦ In October, 1985, G&M, performed a supplemental ground-water sampling and analysis program which included selected monitoring wells, Interceptor Well 1, and

the 004 outfall. This work included analyses for priority pollutant organic compounds. Toluene was the only organic compound that was detected in these samples, at levels at or near the detection limit. Given the low concentrations (9 to 15 ppb) and general consistency of toluene concentrations that were detected, it is suspected that cross-contamination caused by the gasoline powered air compressor that powered the pump used to evacuate the wells prior to sampling and/or possible laboratory-related contributions may be responsible for the toluene levels observed. These water-quality data are provided in Appendix C-3.

♦ Ormet directed G&M in February, 1986 to identify and conceptually develop feasible remedial alternatives to minimize source-area-related contributions and to restore ground-water conditions. This work included surface geophysical surveys to identify possible source areas and plumes of contaminated ground water; soil boring and analysis programs in both the former potliner storage area and the retention ponds to assess the physical nature and chemical make-up of potential source materials; installation of additional monitoring wells in and around suspected source areas; and ground-water monitoring to further define ground-water flow patterns, to characterize the chemical make-up of leachate plumes, and to further assess plume/source-area relationships.

Field work conducted under this investigation was completed prior to the initiation of the present CERCLA-related activities. However, because of the pending CERCLA activities, the findings from this supplemental work have not yet been summarized in a formal report. The data and preliminary interpretations (such as ground-water contour maps and geologic cross-sections) obtained via this supplemental work are provided in Appendix B.

PHASE I REMEDIAL INVESTIGATION
WORK PLAN

2.0 PHASE I SITE INVESTIGATION

Section Two

PHASE I WORK PLAN
REMEDIAL INVESTIGATION
ORMET CORPORATION
HANNIBAL, OHIO

2.0 PHASE I SITE INVESTIGATION (SOW TASK 3)

2.1 DISPOSAL POND WASTE CHARACTERIZATION (SOW TASK 3-A)

Pond solids samples shall be collected and analyzed from each of the five disposal ponds. Natural soils adjacent to the ponds will be physically characterized via soil borings performed around the perimeter of each of the ponds. Details specific to the sampling program for each of the ponds are provided in the following paragraphs.

2.1.1 Disposal Ponds 1 and 2 (SOW TASK 3-A-1)

Both Pond 1 and Pond 2 will be divided into a northern half and a southern half, with solids samples being collected from two (2) boring locations in each pond half (see Figure 2.1-1). Samples shall be collected at three-foot depth intervals in each boring so as to provide approximately four (4) samples per

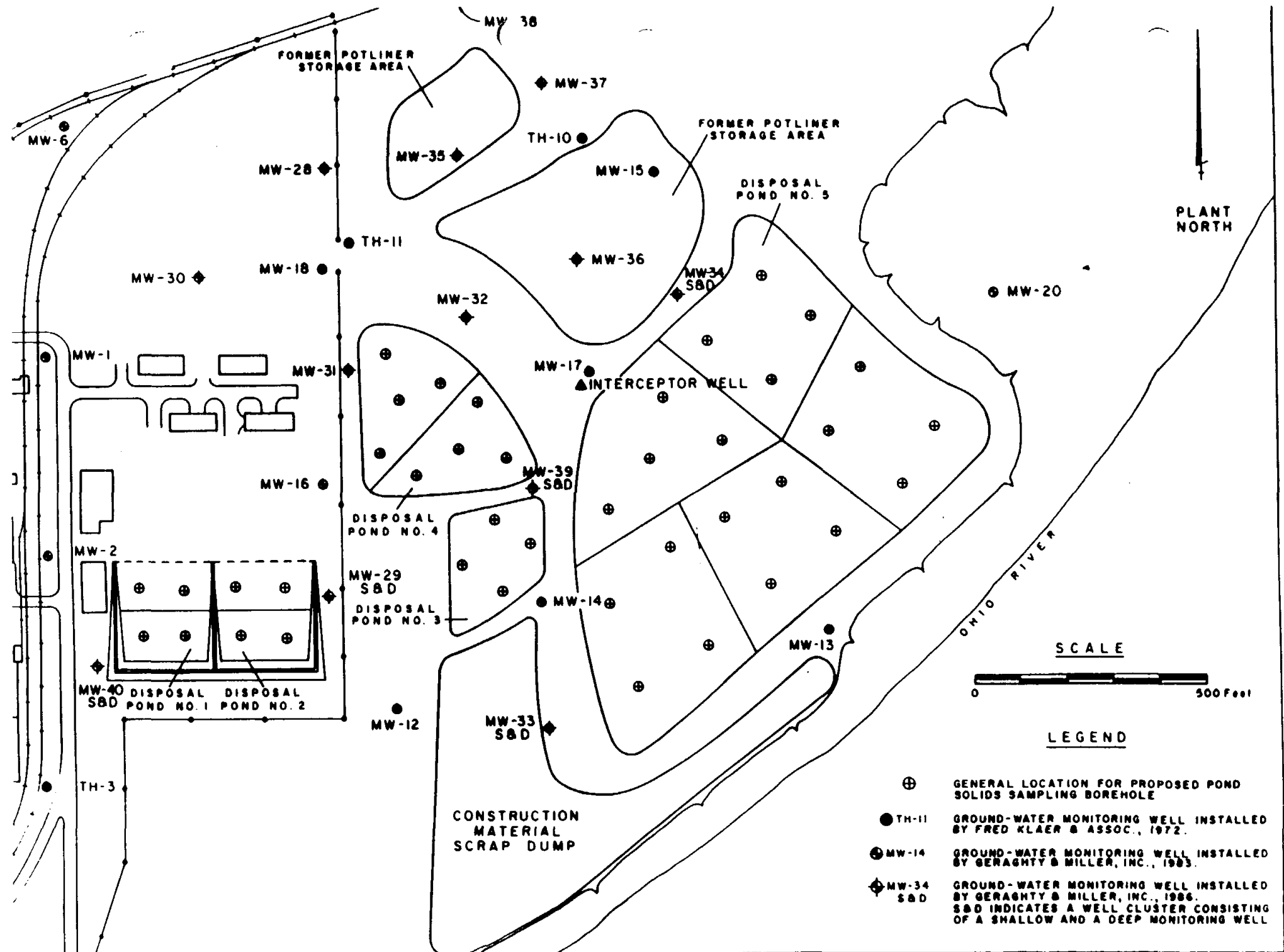


FIGURE 2.1-1 General distribution of disposal pond sampling locations.

boring: at the pond surface, at a depth of approximately three (3) feet, at a depth of approximately six (6) feet, and at the sludge/soil interface. Samples from similar depth intervals in each of the ponds will be combined to form a composite sample for each depth in each pond (i.e., 4 composites from each pond shall be submitted for analysis). To accommodate different pond depths in each boring, samples from the sludge/soil interface will always be composited regardless of depth from which they are collected. In the event that the depth of a pond at any given boring location is not sufficient to permit collection of samples at all four predetermined depth intervals, the lowermost sampling interval (not including the sample from the sludge/soil interface) would be omitted, resulting in the composite for a given depth possibly being formed by fewer than four individual samples.

To assess the permeability of the surface of Pond 1 and Pond 2, one (1) double-ring infiltrometer test shall be performed near the center of each pond. The infiltrometer testing will be conducted in accordance with ~~ASTM method D3385-75~~ "Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometers". A copy of this procedure is provided as Reference 1 at the end of the QAPP.

To evaluate the physical characteristics of the soil beneath the ponds, two (2) soil borings will be performed around the perimeter of each pond. The proposed locations for these borings are shown in Figure 2.1-2. The borings will be advanced via hollow stem auger drilling with continuous split-spoon sampling to a depth of approximately five (5) feet below the level of the pond bottom or until naturally occurring sand and gravel is encountered (as determined by the field geologist), whichever is greater. Information from these perimeter soil borings will be used in conjunction with existing geologic data (i.e., boring logs from monitoring wells MW-29 and MW-40) to estimate the physical characteristics of the soils immediately beneath Ponds 1 and 2.

2.1.2 Disposal Pond 3 (SOW TASK 3-A-1)

Solids samples will be collected from four (4) boring locations in Pond 3. These general locations are shown in Figure 2.1-1.

Samples shall be collected at three-foot depth intervals in each boring so as to provide approximately four (4) samples per boring: at the pond surface, at a depth of approximately three (3) feet, at a depth of approximately six (6) feet, and at the sludge/soil interface. Samples from similar depth intervals in

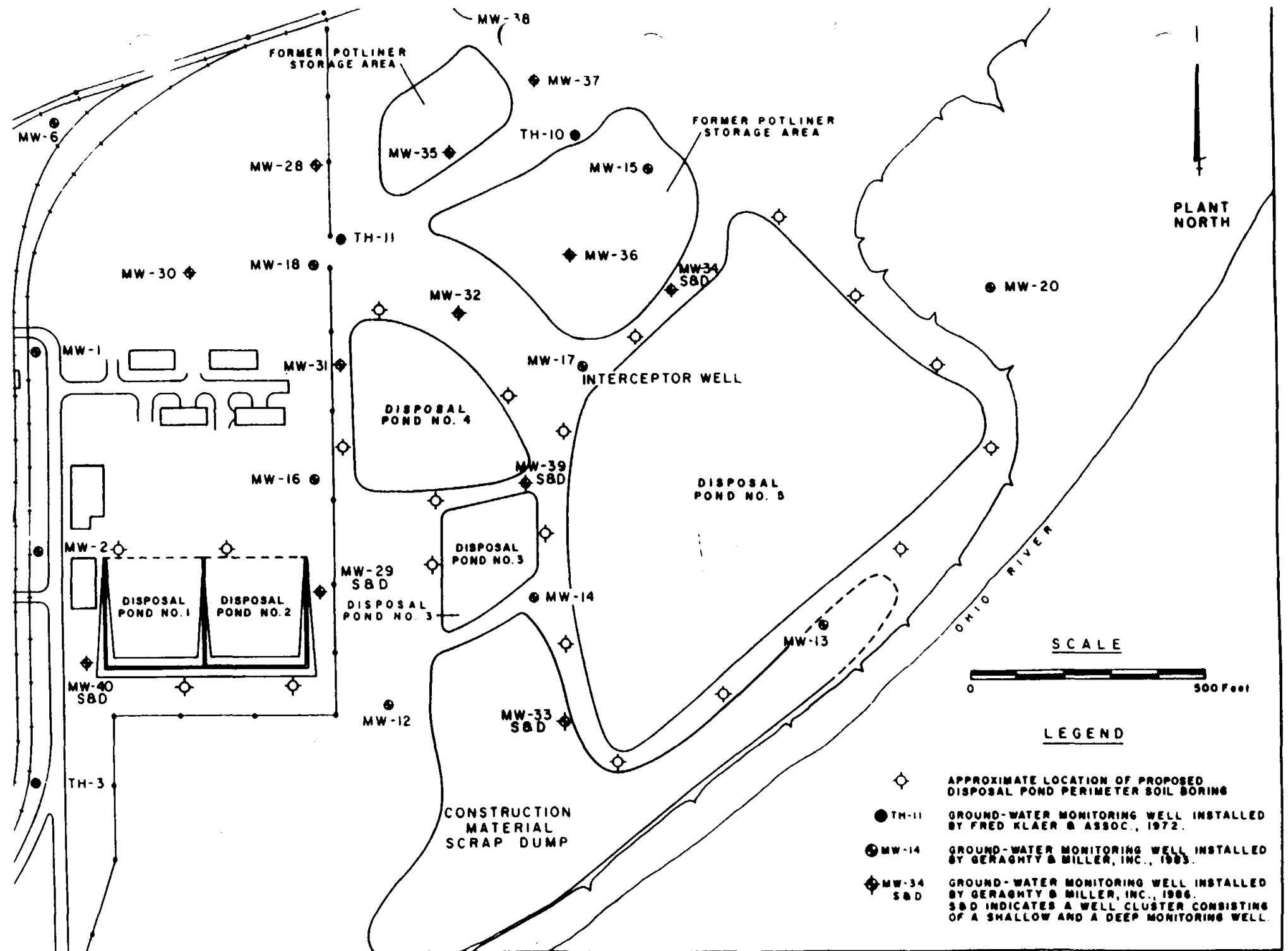


FIGURE 2.1-2 Approximate locations of perimeter soil borings to be performed around disposal ponds during Phase I RI.

the boring will be combined to form a composite sample for each depth in each pond (i.e., 4 composite samples from Pond 3 will be submitted for analysis). To accommodate different pond depths at each boring location, samples from the sludge/soil interface will always be composited regardless of the depth from which they are collected. In the event that the depth of the pond at any given boring location is not sufficient to permit collection of samples at all four predetermined depth intervals, the lowermost sampling interval (not including the sample from the sludge/soil interface) would be omitted, resulting in the composite for a given depth possibly being formed by fewer than four individual samples.

To assess the permeability of the surface of Pond 3, one (1) double-ring infiltrometer test shall be performed near the center of the pond. The infiltrometer testing will be conducted in accordance with ASTM method D3385-75. A copy of this procedure is provided as Reference 1 at the end of the QAPP.

To evaluate the physical characteristics of the soil beneath Pond 3, two (2) soil borings will be performed around the perimeter of the pond. The proposed locations for these borings are shown in Figure 2.1-2. The borings will be advanced via hollow stem auger drilling with continuous split-spoon sampling to a depth of approximately five (5) feet below the level of the

pond bottom or until naturally occurring sand and gravel is encountered (as determined by the field geologist), whichever is greater. Data from these perimeter soil borings will be used in conjunction with existing geologic data (i.e., boring logs from monitoring wells MW-14 and MW-39) to estimate the physical characteristics of the soils immediately beneath Pond 3.

2.1.3 Disposal Pond 4 (SOW TASK 3-A-3)

Disposal Pond 4 will be divided into a northwest section and southeast section. Solids samples will be collected from four (4) boring locations in each section (see Figure 2.1-1).

Samples shall be collected at three-foot intervals in each boring so as to provide approximately four (4) samples per boring: at the pond surface, at a depth of approximately three (3) feet, at a depth of approximately six (6) feet, and near the sludge/soil interface. Samples from similar depths in each pond section will be combined to form a composite sample for each sampling depth in each of the sections (i.e., 4 composite samples from each pond section will be submitted for analysis). To accommodate different pond depths at each boring location, samples from the sludge/soil interface will always be composited regardless of the depth from which they are collected. In the event that the depth of the pond at any given boring location is

not sufficient to permit collection of samples at all four predetermined depth intervals, the lowermost sampling interval (not including the sample from the sludge/soil interface) would be omitted, resulting in the composite for a given depth possibly being formed by fewer than four individual samples.

To assess the permeability of the surface of Pond 4, one (1) double-ring infiltrometer test shall be performed near the center of each pond section. The infiltrometer testing will be conducted according to ASTM method D3385-75, which is presented as Reference 1 at the end of the QAPP.

To evaluate the physical characteristics of the soil beneath Pond 4, four (4) soil borings will be performed around the perimeter of the pond. The proposed locations for these borings are shown in Figure 2.1-2. The borings will be advanced via hollow stem auger drilling with continuous split spoon sampling to a depth of approximately five feet below the level of the pond bottom or until naturally occurring sand and gravel is encountered (as determined by the field geologist), whichever is greater. Data from these perimeter soil borings will be used in conjunction with existing geologic data (i.e. boring logs from monitor wells MW-31 and MW-39) to estimate the physical characteristics of the soils immediately beneath Pond 4.

2.1.4 Disposal Pond 5 (SOW TASK 3-A-4)

Disposal Pond 5 will be divided into five sections, with each of four sections including one of the historical discharge lines. The fifth section will include that area of the pond not serviced by the four discharge lines (see Figure 2.1-1). Solids samples will be collected from four (4) boring locations in each of the pond sections.

Samples shall be collected at five-foot intervals in each boring so as to create approximately five (5) samples per boring: one at the pond surface, one at a depth of five (5) feet, one at a depth of ten (10) feet, one at a depth of fifteen (15) feet, and one at the sludge/soil interface. Samples from similar depths in each of the sections will be combined to form a composite sample for each depth in each section (i.e., 5 composite samples from each pond section will be submitted for analysis). To accommodate different pond depths at each boring location, samples from the sludge/soil interface will always be composited regardless of the depth from which they are collected. In the event that the depth of the pond at any given boring location is not sufficient to permit collection of samples at all five established depth intervals, the lowermost sampling interval (not including the sample from the sludge/soil interface) will be

omitted at that location, resulting in the composite from a given depth possibly being formed by fewer than four individual samples.

To assess the permeability of the pond surface, one (1) double-ring infiltrometer test shall be performed near the center of each pond section. The infiltrometer testing will be conducted according to ASTM method D3385-75, which is presented as Reference 1 at the end of the QAPP.

To evaluate the physical characteristics of the soil beneath Pond 5, ten (10) soil borings will be performed around the perimeter of the pond. The proposed locations for these borings are shown in Figure 2.1-2. The borings will be advanced via hollow stem auger drilling with continuous split-spoon sampling to a depth of approximately five (5) feet below the level of the pond bottom or until naturally occurring sand and gravel is encountered (as determined by the field geologists), whichever is greater. Data from these perimeter soil borings will be used in conjunction with existing geologic data (i.e. boring logs from monitoring wells MW-34, MW-17, and MW-13) to estimate the physical characteristics of the soils immediately beneath Pond 5.

Details regarding the sampling equipment and procedures to be utilized in the pond solids sampling program are provided in

Section 3.6.2 of the QAPP. Protocols for conducting the soil perimeter boring activities are presented in Section 3.6.1 of the QAPP.

2.1.5 Sludge Analyses for All Ponds (SOW TASK 3-A-5)

All composite pond solids samples will be analyzed for the parameters listed in Table 2.1-1.

TABLE 2.1-1

PARAMETERS TO BE ANALYZED FOR ON ALL
COMPOSITE POND SOLIDS SAMPLES

pH-Laboratory	Solids (% by weight)
Ammonia-nitrogen	Total Organic Carbon
Fluoride	Alkalinity
Silica (as SiO ₂)	Chloride
Cyanide (total)	Sulfate
Cyanide (amenable to chlorination)	

Organic and inorganic parameters outlined in the U.S. EPA CLP List, including PCBs and excluding pesticides and 2, 3, 7, 8 dioxin.

Procedures and protocols to be followed in conducting the analyses of the disposal pond solids are provided in Section 3.9.0 of the Quality Assurance Project Plan.

2.2 WASTE POTLINER STORAGE AREA

CHARACTERIZATION (SOW TASK 3-B)

To assess the characteristics of the soils in the former potliner storage area, the area will be gridded off into approximately 200-foot by 200-foot sections (see Figure 2.2-1). A total of 24 sections will be created. A soil boring will be performed in the center of each section to a depth of ten (10) feet, utilizing hollow stem auger drilling with continuous split-spoon sampling. Samples from each boring will be composited over the following depth intervals: 0-2 feet, 2-4 feet, 4-6 feet, 6-8 feet, and 8-10 feet. Each of the composite samples (approximately 120 total) shall be analyzed for calcium, sodium, fluoride, ammonia-nitrogen, pH, and total cyanide.

Based upon the results of these analyses, all composite samples from the borings in four (4) sections shall be analyzed for the organic and inorganic parameters of the U.S. EPA CLP list, including PCBs but excluding pesticides and 2, 3, 7, 8 dioxin. Depending upon the variability of the analyses performed on the composites from these four borings, all composites from up to four (4) additional sections may be analyzed for a similar list of parameters.

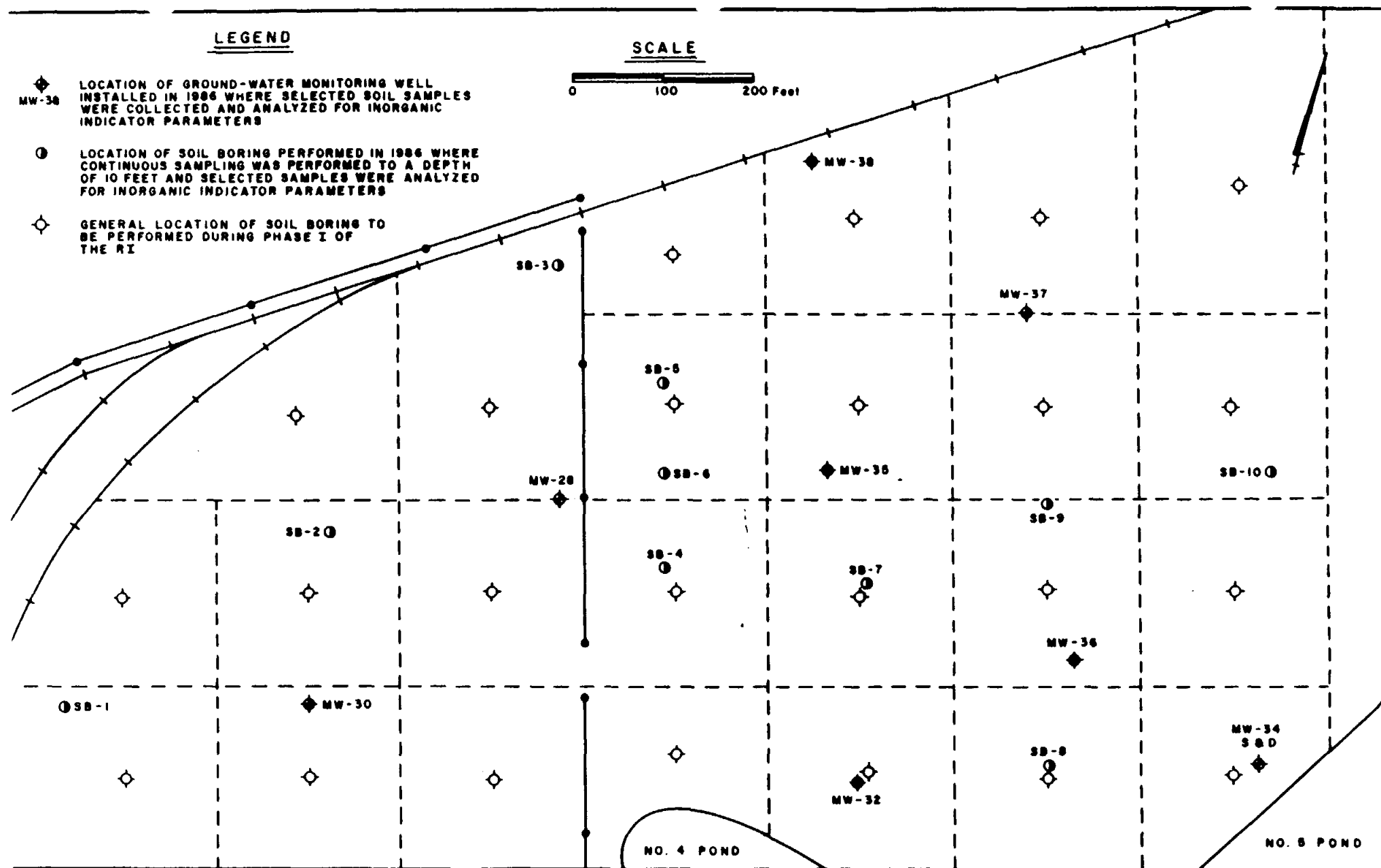


FIGURE 2.2-1 General diagram of 200-foot by 200-foot grid system and associated soil borings to be performed in the former potliner storage area during Phase I of the RI.

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Procedures and protocols for performing these soil boring activities are outlined in Section 3.6.1 of the QAPP. Laboratory procedures and protocols for conducting the analyses of the soil samples are provided in Section 3.9.0 of the QAPP.

2.3 SEEP SAMPLING (SOW TASKS 3-C, 3-I, AND 3-J)

Four seeps identified during the November 20, 1986 site visit by U.S. EPA and OEPA shall be sampled. Two of these seeps are located at the base of the southwest corner of the construction material scrap dump and two are situated at the toe of the slope leading down to the Ormet baseball field. The general locations of these seeps are shown in Figure 2.3-1. Also, the corrugated steel pipe that extends from the eastern berm of Pond 5 (see Figure 2.3-1) shall be sampled, if water is flowing from it at the time of sampling. The seep and pipe samples will be analyzed for all parameters listed in Table 2.3-1. Procedures and protocols for the sampling and analysis of the four seeps and the steel pipe will be in general accordance with those outlined in Section 3.6.5 and 3.9 respectively, of the QAPP.

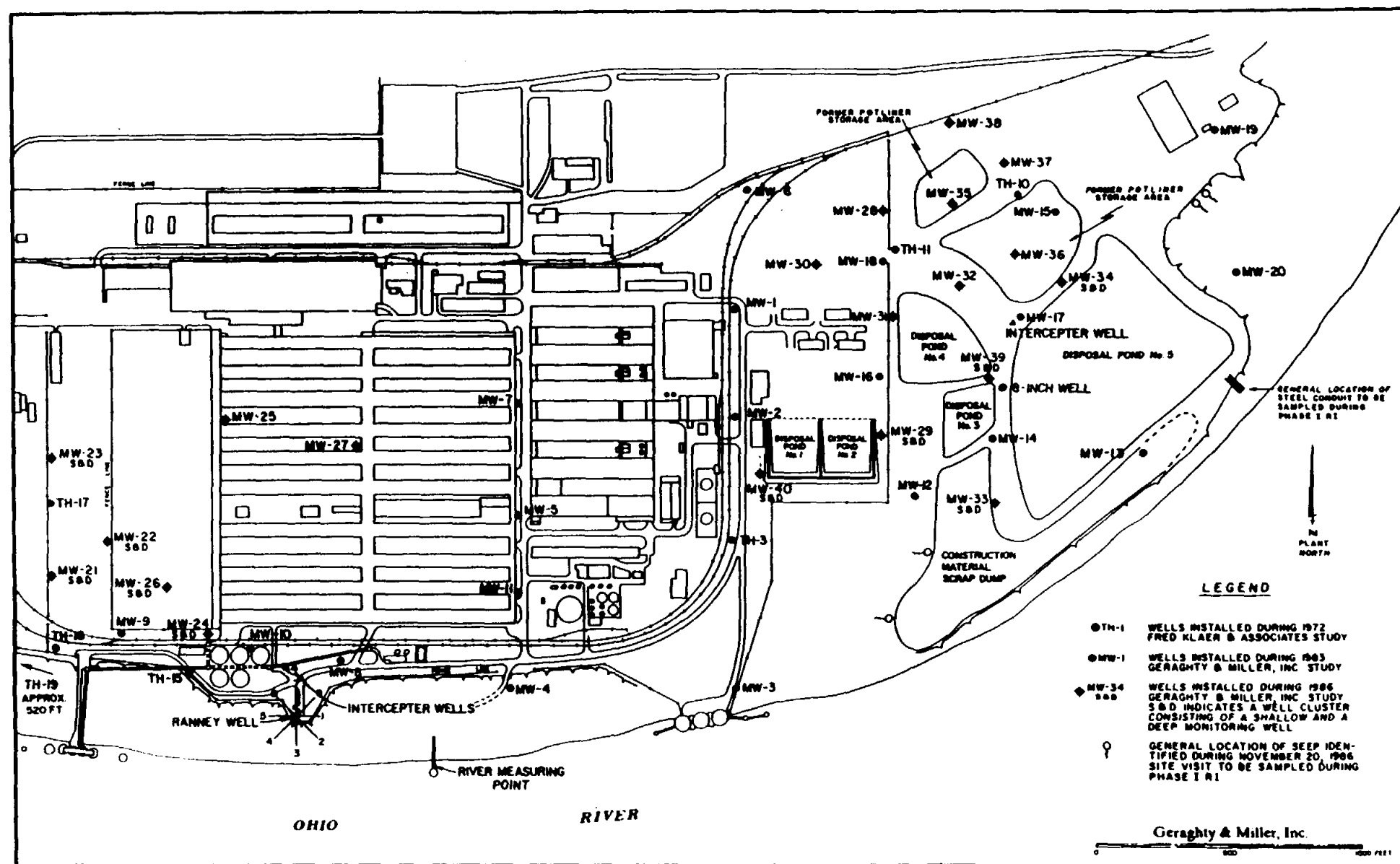


FIGURE 2.3-1 Approximate locations of seeps and steel conduit to be sampled during Phase I RI.

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Table 2.3-1

Water Quality Parameters to be
Analyzed for on Seep and Pipe Samples

pH -Field and laboratory

Specific conductance - field and laboratory

Ammonia - nitrogen

Fluoride

Total Dissolved Solids

Total Organic Carbon

Alkalinity

Chloride

Sulfate

Silica (Dissolved)

Cyanide (total)

Cyanide (Amenable to Chlorination)

Organic and inorganic parameters outlined in the U.S. EPA
CLP list excluding PCBs, pesticides, and 2, 3, 7, 8 dioxin.

2.4 OHIO RIVER SEDIMENTS CHARACTERIZATION (SOW TASK 3-D)

One sample from the upper foot of river sediments shall be taken from each of the six (6) general sampling locations shown in Figure 2.4-1. This includes an upstream sample to determine background conditions and a sample in the backwater area of outfall 004.

Whole samples (sediment and interstitial water) will be analyzed for the parameters listed in Table 2.4-1. To assess any past or current alterations to Ohio River sediments, analytical results will be compared to the data from the background sample. The background sample shall be collected upstream from the confluence of the Ohio River and the small stream which flows generally north to south near the eastern edge of the baseball field. Procedures for collecting the river sediment samples are provided in Section 3.6.4 of the QAPP.

TABLE 2.4-1

PARAMETERS TO BE ANALYZED FOR ON OHIO RIVER SEDIMENTS SAMPLES

pH (laboratory)	Chloride
Ammonia-nitrogen	Sulfate
Fluoride	Silica (as SiO ₂)
Total Organic Carbon	Cyanide (total)
Alkalinity	Cyanide (amenable to chlorination)

Organic and inorganic parameters outlined in the U.S. EPA CLP list including PCBs (if found to be present in disposal pond solids or in waste potliner storage areas), but excluding pesticides, and 2, 3, 7, 8 dioxin.

Procedures and protocols for conducting the analyses of the river sediment samples are provided in Section 3.9.0 of the Quality Assurance Project Plan.

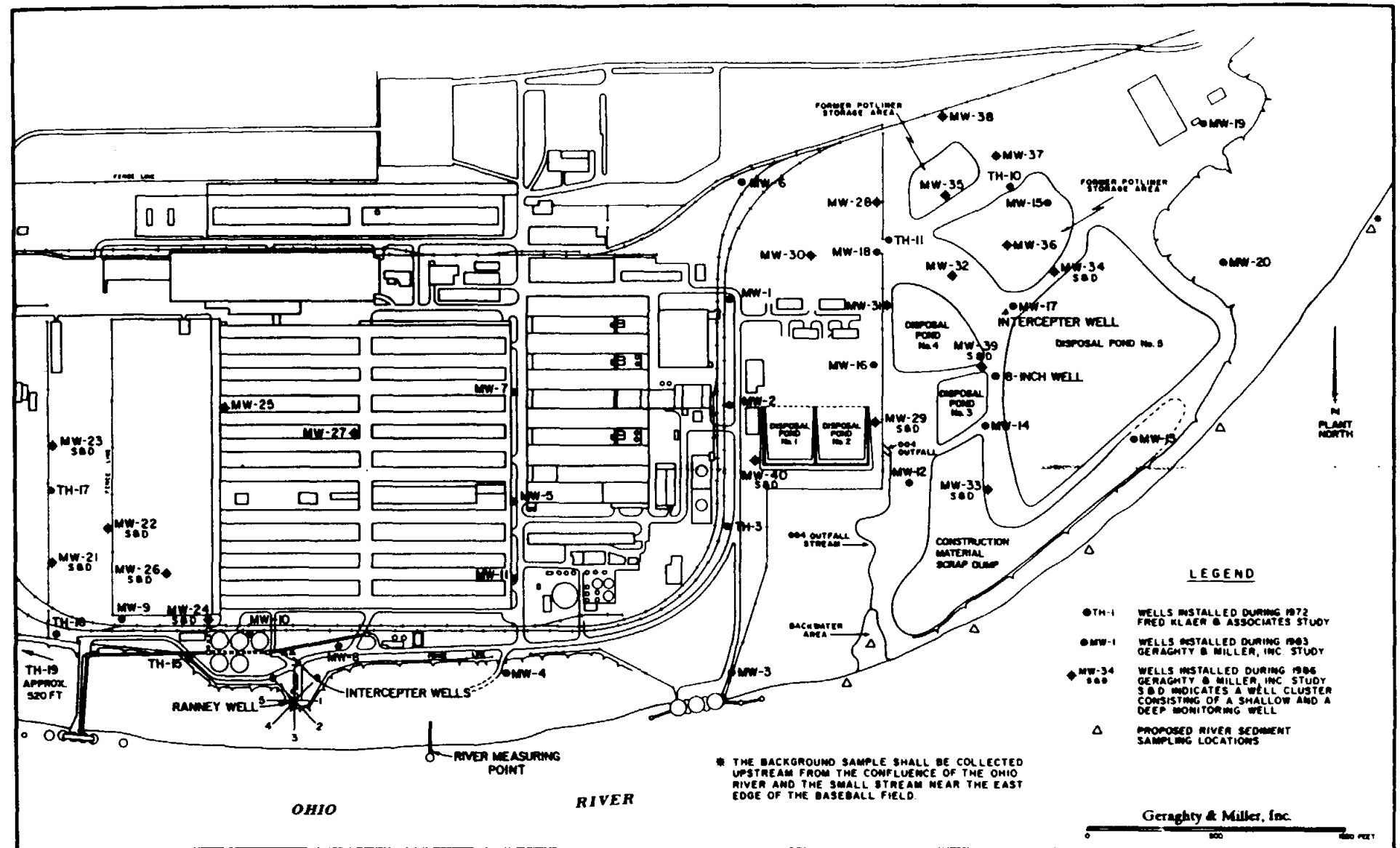


FIGURE 2.4-1. Approximate locations for Ohio River sediment sampling to be performed during Phase I of the RI.

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2.5 MONITORING WELL INSTALLATION (SOW TASK 3-E)

Three additional ground-water monitoring wells will be installed at the general locations shown in Figure 2.5-1. These wells will be installed via hollow stem auger (HSA) drilling down to the bedrock surface, with split-spoon samples being collected at regular 5-foot intervals. Wherever the saturated aquifer thickness is found to exceed 20 feet, a two-well cluster will be installed to provide zone-specific monitoring of the upper and lower portion of the aquifer. Descriptions of the soil sampling and well installation procedures and generalized well construction diagrams are provided in the Sections 3.6.1 of the QAPP.

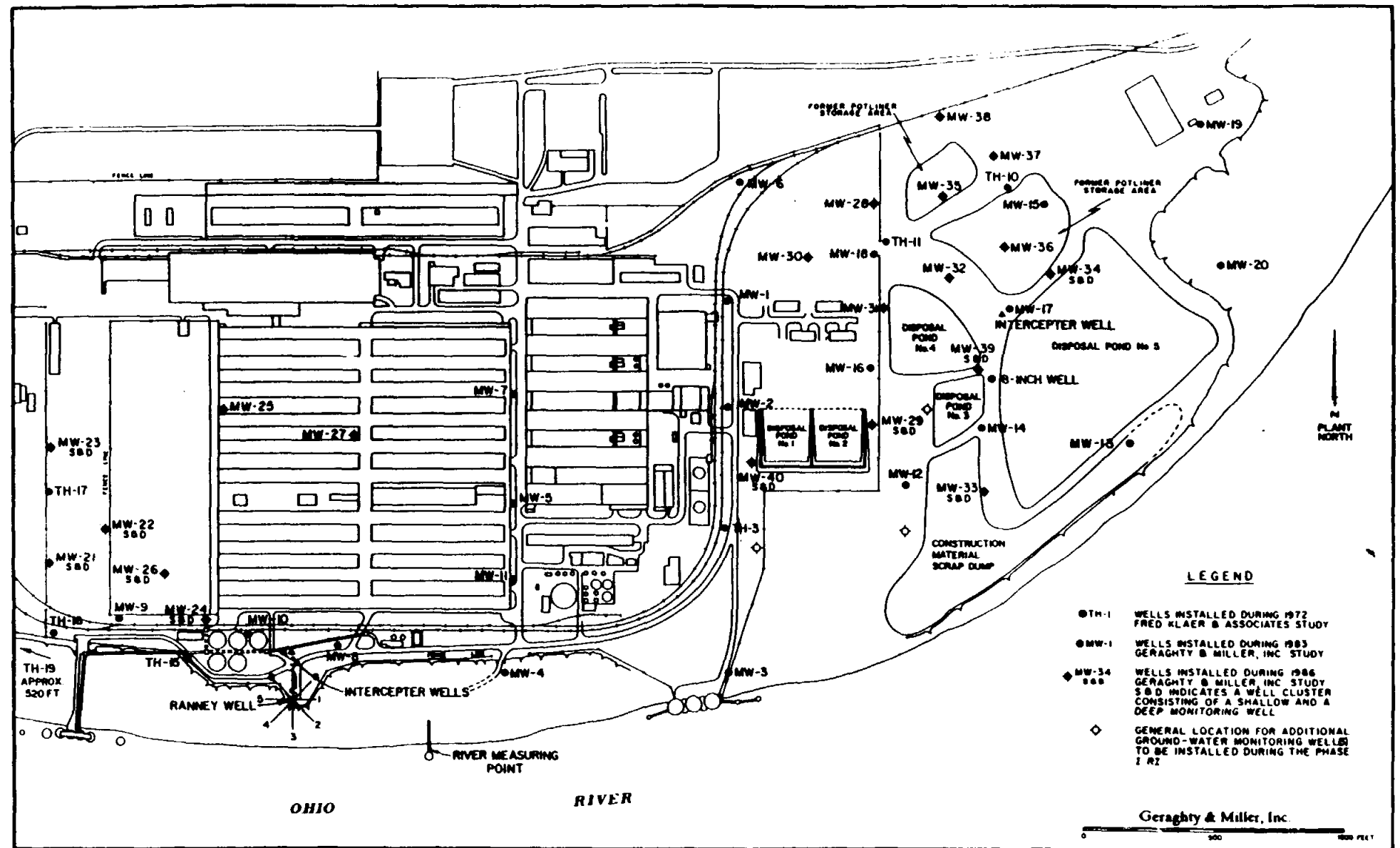


FIGURE 2.5-1 General locations for additional ground-water monitoring wells proposed to be installed during Phase I of the RI.

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2.6 GROUND WATER SAMPLING (SOW TASK 3-F)

Following installation and development of the additional ground-water monitoring wells specified in Section 2.5, all MW-series monitoring wells at the Ormet facility will be sampled (see Figure 2.6-1). Analyses of samples will be performed by a laboratory approved by U.S. EPA and OEPA. All MW-series monitoring wells at the site shall be analyzed for the inorganic parameters listed in Table 2.6-1. In addition, monitoring wells MW-2, 5, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 28, 29s, 29d, 30s, 31, 32, 33s, 33d, 34s, 34d, 35, 36, 37, 39s, 39d, 40s, 40d, and the additional wells installed under Section 2.5 will also be analyzed for the list of parameters in Table 2.6-2. Descriptions of the Ground-Water Sampling and Laboratory Analytical protocols are provided in Sections 3.6.5 and 3.9.0, respectively, of the QAPP.

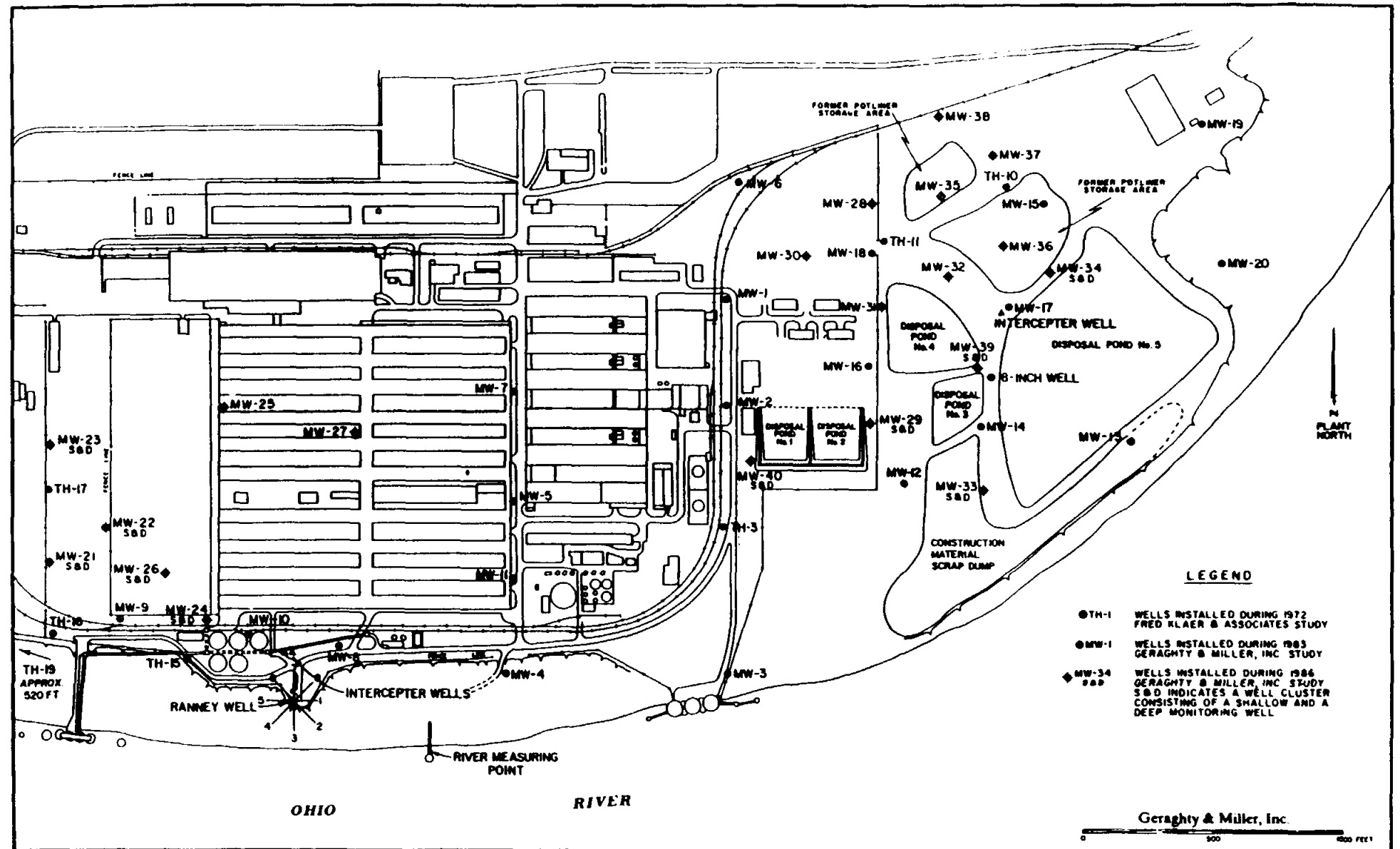


FIGURE 2.6-1 Locations of existing MW-series monitoring wells to be sampled during the Phase I RI.

TABLE 2.6-1

WATER QUALITY PARAMETERS TO BE ANALYZED FOR
ON ALL GROUND-WATER MONITORING WELL SAMPLES

pH (field and laboratory)	Manganese
Specific conductance	Iron (total)
(field and laboratory)	Zinc
Ammonia-nitrogen	Copper
Total Dissolved Solids	Nickel
Total Organic Carbon	Cobalt
Alkalinity	Chromium (total)
Chloride	Lead
Fluoride	Cadmium
Sulfate	Barium
Sodium	Aluminum
Potassium	Silica (dissolved)
Calcium	Cyanide (total)
Magnesium	Cyanide (Amenable to Chlorination)
	Selenium
	Arsenic

TABLE 2.6-2

ADDITIONAL WATER QUALITY PARAMETERS TO BE ANALYZED FOR
ON SELECTED GROUND-WATER MONITORING WELL SAMPLESINORGANICS

Antimony	Thallium
Beryllium	Tin
Mercury	Vanadium
Silver	

VOLATILES

Chloromethane	1, 2-Dichloropropane
Bromomethane	trans-1,3-Dichloropropene
Vinyl Chloride	Trichloroethene
Chloroethane	Dibromochloromethane
Methylene Chloride	1, 1, 2-Trichloroethane
Acetone	Benzene
Carbon Disulfide	cis-1, 3-Dichloropropene
1, 1-Dichloroethene	2-Chloroethyl Vinyl Ether
1, 1-Dichloroethane	Bronoform
trans-1, 2-Dichloroethene	2-Hexanone
Chloroform	4-Methyl-2-pentanone
1, 2-Dichloroethane	Tetrachlorethene
2-Butanone	Toluene
1, 1, 1-Trichloroethane	Chlorobenzene
Carbon Tetrachloride	Ethyl Benzene
Vinyl Acetate	Styrene
Bromodichloromethane	Total Xylenes
1, 1, 2, 2-Tetrachloroethane	

SEMI-VOLATILES

Phenol	Acenaphthene
bis (2-Chloroethyl) ether	2, 4-Dinitrophenol
2-Chlorophenol	4-Nitrophenol
1, 3-Dichlorobenzene	Dibenzofuran
1, 4-Dichlorobenzene	2, 4-Dinitrotoluene
Benzyl Alcohol	2, 6-Dinitrotoluene
1, 2-Dichlorobenzene	Diethylphthalate
2-Methylphenol	4-Chlorophenyl Phenyl ether
bis (2-Chloroisopropyl) ether	Fluorene
4-Methylphenol	4-Nitroaniline
N-Nitroso-Dipropylamine	4, 6-Dinitro-2-methylphenol

TABLE 2.6-2 (continued)

ADDITIONAL WATER QUALITY PARAMETERS TO BE ANALYZED FOR
ON SELECTED GROUND-WATER MONITORING WELL SAMPLESSEMI-VOLATILES (continued)

Hexachloroethane	Nitrosodiphenylamine
Nitrobenzene	4-Bromophenyl Phenyl ether
Isophorone	Hexachlorobenzene
2-Nitrophenol	Pentachlorophenol
2, 4-Dimethylphenol	Phenanthrene
Benzoic Acid	Anthracene
bis (2-Chloroethoxy) methane	Di-n-butylphthalate
2, 4-Dichlorophenol	Fluoranthene
1, 2, 4-Trichlorobenzene	Pyrene
Naphthalene	Butyl Benzyl Phthalate
4-Chloroaniline	3, 3'-Dichlorobenzidine
Hexachlorobutadiene	Benzo(a)anthracene
4-Chloro-3-methylphenol	bis (2-ethylhexyl) phthalate
(para-chloro-meta-cresol)	Chrysene
2-Methylnaphthalene	Di-n-octyl Phthalate
Hexachlorocyclopentadiene	Benzo(b) fluoranthene
2, 4, 6-Trichlorophenol	Benzo(k) fluoranthene
2, 4, 5-Trichlorophenol	Benzo(s) pyrene
2-Chloronaphthalene	Indeno (1, 2, 3-cd)pyrene
2-Nitroaniline	Dibenz(a, h)anthracene
Dimethyl Phthalate	Benzo (g, h,i) perylene
Acenaphthylene	
3-Nitroaniline	

Pesticides

alpha-BHC	Endosulfan Sulfate
beta-BHC	4, 4'-DDT
delta-BHC	Endrin Ketone
gamma-BHC (Lindane)	Methoxychlor
Heptachlor	Chlordane
Aldrin	Toxaphene
Heptachlor Epoxide	AROCLOR-1016
Endosulfan I	AROCLOR-1221
Dieldrin	AROCLOR-1232
4, 4'-DDE	AROCLOR-1242
Endrin	AROCLOR-1248
Endosulfan II	AROCLOR-1254
4, 4'-DDD	AROCLOR-1260
Endrin Aldehyde	

2.7 CARBON RUNOFF AND DEPOSITION AREA (SOW TASK 3-G)

During a site visit by U.S. EPA and OEPA on November 20, 1986, three areas of carbon deposition were identified in a portion of the plant located between Ponds 1 and 2 and the Ohio River (see Figure 2.7-1). At each of these three deposition areas, two samples of the carbon material and two samples of the underlying soil shall be collected. These whole samples shall be analyzed for the parameters listed in Table 2.7-1.

Also, the entire wooded area approximately bounded on the west by the toe of the embankment below the plant fence line between wells MW-3 and MW-40, on the east by the 004 outfall stream, on the north by the fence line south of Ponds 1 and 2, and on the south by the Ohio River, shall be gridded off. The grid system will consist of 50-foot by 50-foot sections. To generally assess the vertical and lateral distribution of the carbon deposits, hand augered soil borings will be performed at the intersection of each grid line (see Figure 2.7-1).

Section 3.6.3 of the QAPP provides the procedures and protocols to be utilized in performing the assessment of the carbon runoff and deposition area.

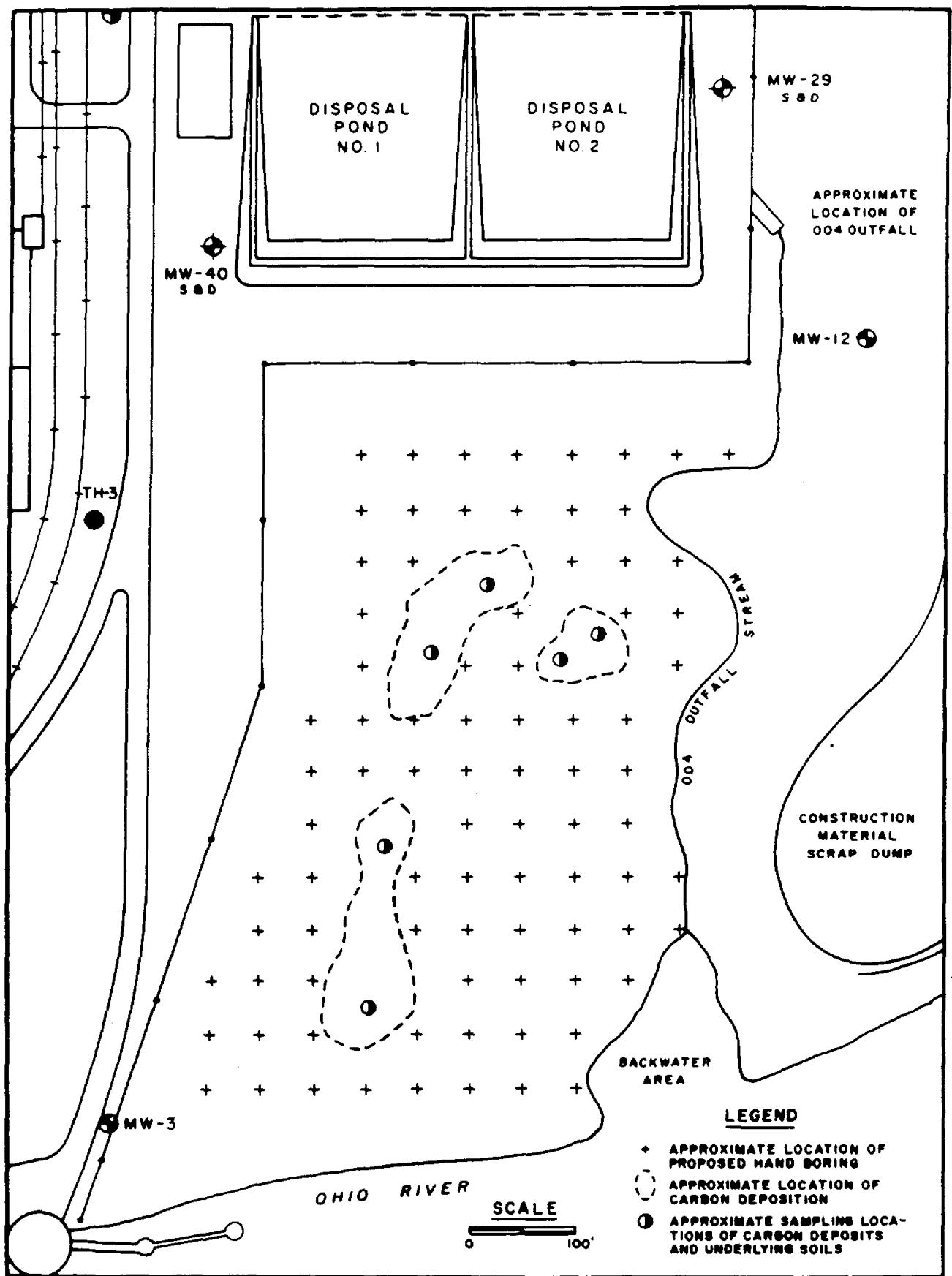


FIGURE 2.7-1 General locations of areas of carbon runoff deposition and approximate sampling locations

TABLE 2.7-1

PARAMETERS TO BE ANALYZED FOR ON
CARBON MATERIAL AND UNDERLYING SOILS

pH-laboratory	Sulfate
Total Organic Carbon	Silica (SiO ₂)
Alkalinity	Cyanide (total)
Chloride	Cyanide (amenable to
Fluoride	chlorination)

Organic and inorganic parameters outlined in the U.S. EPA CLP list excluding PCBs, pesticides, and 2, 3, 7, 8 dioxin.

2.8 AIR MONITORING (SOW TASK 3-H)

Ormet has contracted Energy & Environmental Management, Inc. (E²M) of Murrysville, Pa. to design and conduct the air monitoring study outlined in Task 3-H of the SOW.

It is the intent of the air monitoring program to assess the combined effect of the two suspected sources of contaminant release: the disposal ponds and the former potliner storage areas.

2.8.1 Review of Meteorological Data

Ormet maintains a wind speed and direction recording system at its Hannibal facility. The wind sensor is located in the "Substation" area of the facility as shown in Figure 2.8-1, a section of a 1976 U.S. Geological Survey Map. The 1976 declination value of 5 degrees West is shown in Figure 2.8-1 for magnetic north from true north. The U.S. Geological Survey estimates the current declination at 6 degrees 44 minutes west.

Strip chart records for a 12 month period (May, 1986 through April, 1987) were analyzed for average hourly wind speed and direction. That data was sorted into ranges of wind direction

TABLE 2.8-2

WIND DIRECTION ARCS FOR DETERMINING IMPACT

<u>Impact</u>	<u>Site</u> <u>Background</u>	<u>Wind Direction</u> <u>Arc (Deg)</u>	
		<u>Beginning</u>	<u>End</u>
AM-1	AM-2	143	180
	AM-3*	180	210
	AM-4	210	242
AM-2	AM-3	210	243
	AM-4	243	262
	AM-1**	262	290
AM-3	AM-4	347	7
	AM-1Δ	7	40
	AM-2	40	68
AM-4	AM-1ΔΔ	14	56
	AM-2	56	110
	AM-3	110	195

* Arc from 195° to 218° reflects influence from both sources.

** Arc from 260° to 290° reflects influence from both sources.

Δ Arc from 7° to 33° reflects influence from both sources.

ΔΔ Arc from 40° to 62° reflects influence from both sources.

Note: Impact is determined by subtracting background site from impact site within wind direction arcs.

from the Hi-Vol samplers. These filters will be folded and placed in a pre-addressed and stamped envelope and shipped to Hazen Research, Inc. in Golden, Colorado for weighing. Details of the installation, operation and calibration of equipment and QA/QC procedures to be followed during the program are described in Section 3.6.7.

E²M will install a wind speed and direction recorder at Site AM-2 at an elevation of approximately 2 to 3 meters. This equipment will serve as a backup to the existing Ormet primary meteorological station. Ten percent of the wind speed and direction data from the temporary recorder will be compared on a random basis to the Ormet equipment. Locations of the sites are shown on Figure 2.8-6. Data on precipitation events will be obtained from the U.S. Army Corps of Engineers at the Hannibal Lock and Dam, about 3 1/2 river miles downriver of the Ormet facility. Snow cover data, if available, will be used in data analysis.

Data will be reported in tabular form and also in a spatial form. For the days that the monitors are running, hourly wind speed and direction data will be tabulated on a map showing the PM₁₀ concentrations at their respective locations. A vector sum for the day will also be included on the map.

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The program should be started such that the winter period (December through April) is included in the ten month period. Winds from the northeast are dominant during this period. Site AM-1 and AM-2 would yield low background concentrations. Sites AM-3 and AM-4 would see only the influence of the ponds under these conditions.

2.9 PLANT RECREATION AREA WASTE INVESTIGATION (SOW TASK 3-J)

During the November 20, 1986 site visit by U.S. EPA and OEPA an area of backfill material was identified on the slope leading down to the baseball field (see Figure 2.9-1).

To assess the general composition of fill material within this area, one (1) soil boring shall be performed in the horseshoe-pit area and two (2) soil borings shall be conducted on the baseball field near the base of the slope. General locations for these proposed borings are shown in Figure 2.9-1.

The borings will be advanced via hollow stem auger drilling, with continuous split-spoon sampling to a depth five (5) feet into naturally occurring soils (as determined by the field geologists). The physical characteristics of the material encountered in the borings will be logged and reported. A detailed description of the procedures and protocols to be used in the recreation area soil boring program is provided in Section 3.6.1 of the QAPP.

At the time of the site visit, two seeps were found to be flowing from the base of this fill area. These seeps will be sampled and analyzed in accordance with Section 2.3 of this Phase I Work Plan.

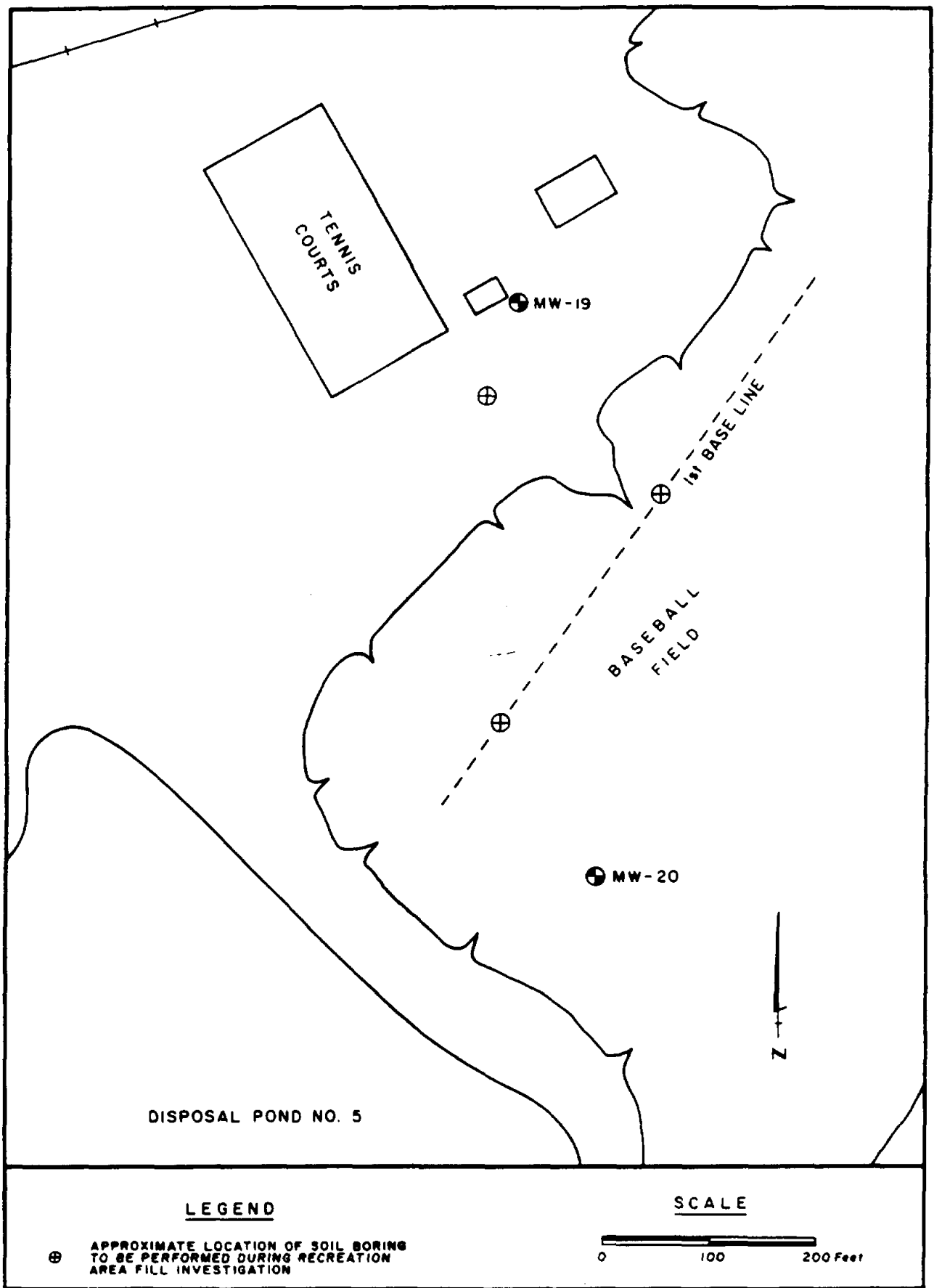


FIGURE 2.9-1 General locations of soil borings to be performed during recreation area fill investigation.

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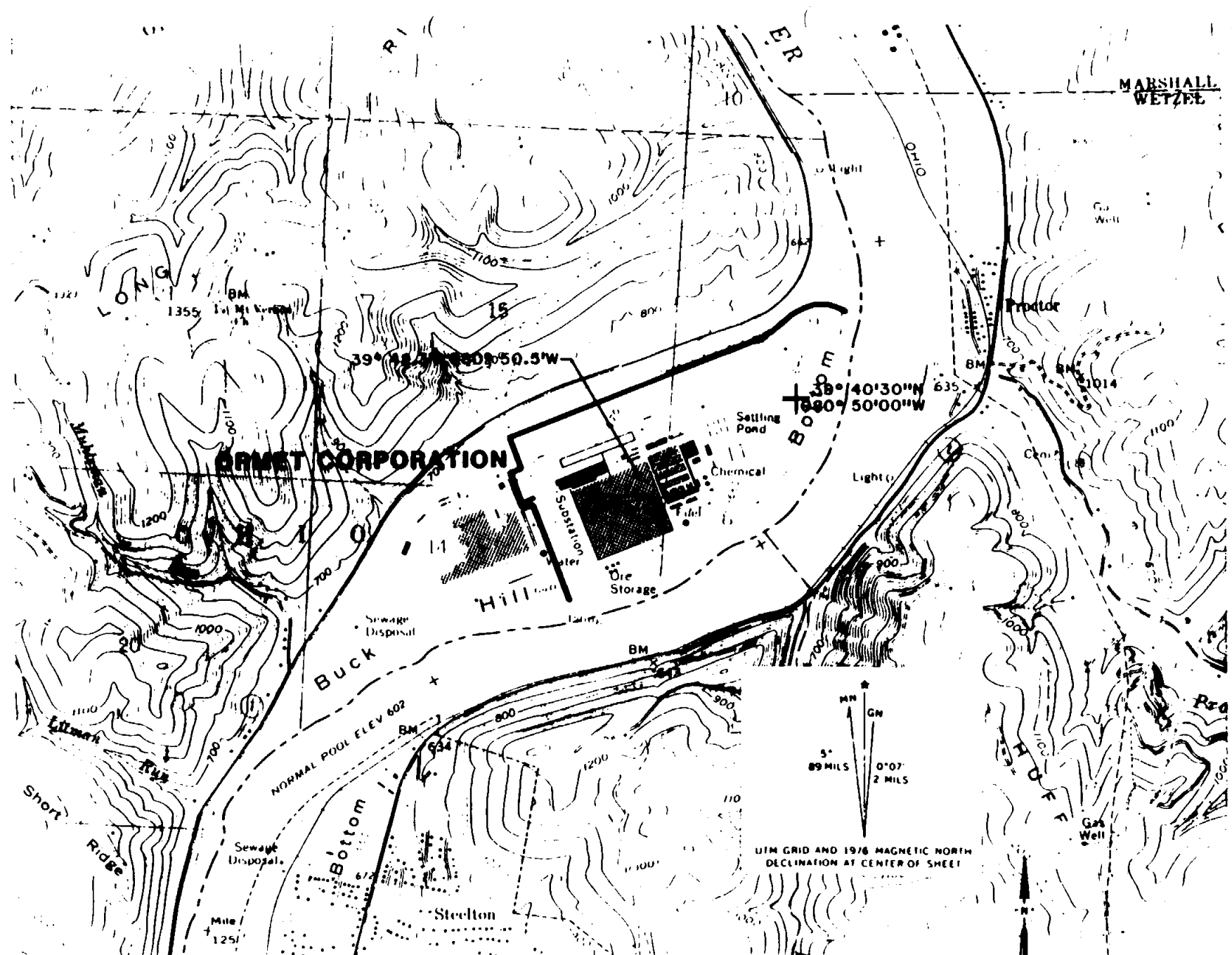


FIGURE 2.8-1. Location Ormet Facility

and speed to present the distributional pattern of wind vector. Results of that analysis are tabulated in Table 2.8-1 and wind roses for four of the 12 months are presented graphically in Figures 2.8-2 through 2.8-5. A visual inspection of Table 2.8-1 reveals the dominance of the southwest winds at the site from May, 1986 through December, 1986. A noticeable shift occurs, beginning in January, 1987, where winds from the northeast become the dominant wind direction. For the entire 12 month data set, the frequency distribution follows:

<u>Direction</u>	<u>% Occurrence by Wind Speed (MPH)</u>						<u>TOTAL</u>
	<u>0-4</u>	<u>5-8</u>	<u>9-12</u>	<u>13-16</u>	<u>17-20</u>	<u>>20</u>	
North	1.2	4.4	0.6	-	-	-	6.2
Northeast	2.9	10.2	3.4	0.1	-	-	16.6
East	1.4	1.4	<0.1	-	-	-	2.8
Southeast	0.9	0.7	0.1	-	-	-	1.6
South	2.1	2.5	0.9	0.1	-	-	5.6
Southwest	9.9	16.1	6.2	1.7	0.3	<0.1	34.2
West	9.9	9.7	1.8	0.4	<0.1	-	21.8
Northwest	4.0	5.5	1.4	0.1	<0.1	-	11.0
TOTAL	32.3	50.5	14.3	2.4	0.3	<0.1	100.0

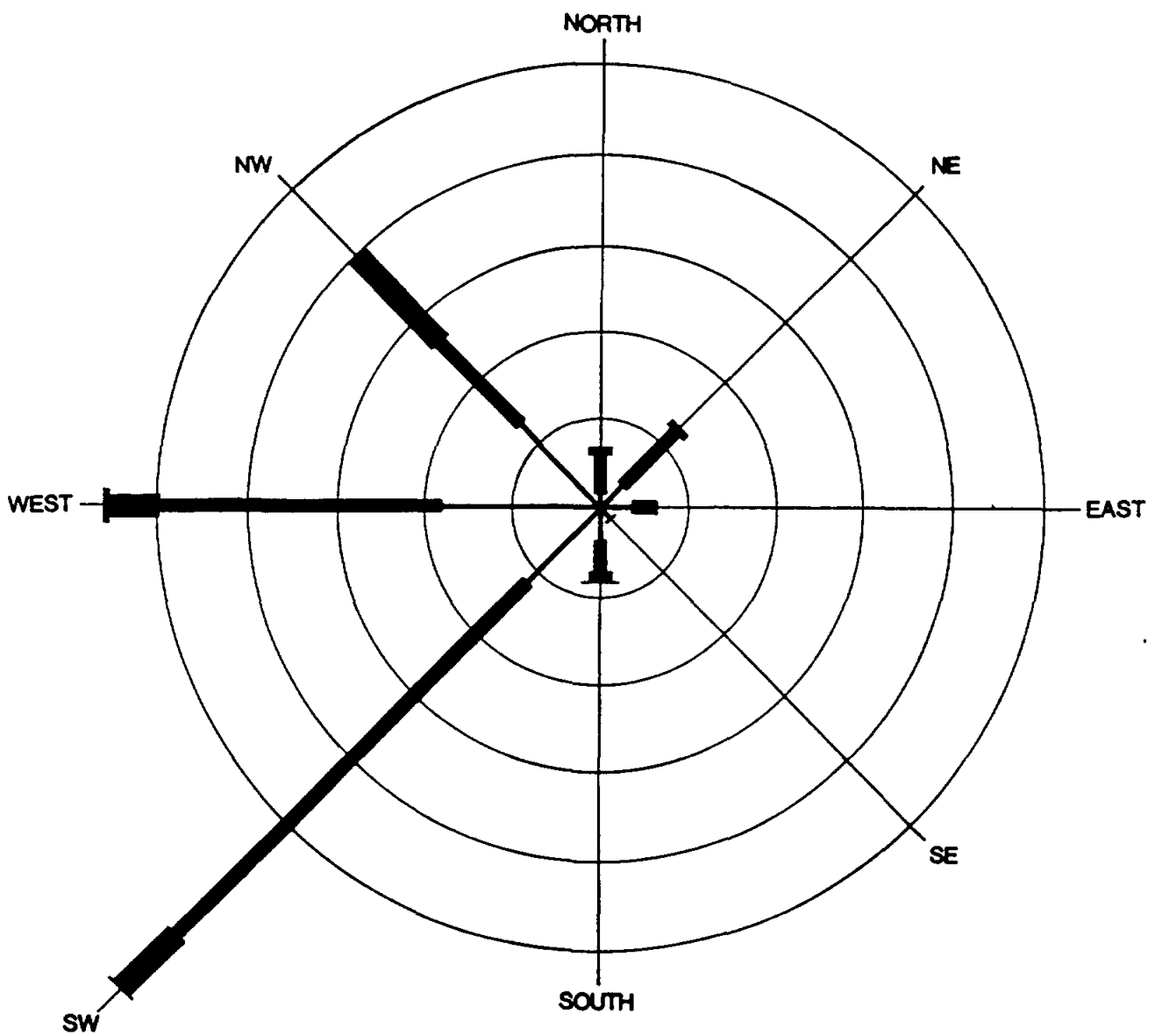
TABLE 2.8-1

WIND ROSE BY MONTH AS PERCENT BY DIRECTION AND SPEED FOR MAY 1986
THROUGH APRIL 1987 AT ORMET FACILITY

	May 1986							June 1986							July 1986						
	0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20	
North	0.6	3.9	0.1	-	-	-		1.7	2.0	-	-	-	-		0.8	2.3	0.3	-	-	-	
Northeast	5.7	8.1	0.9	0.4	-	-		6.4	7.2	-	-	-	-		1.8	4.3	0.3	-	-	-	
East	0.7	-	-	-	-	-		0.9	-	-	-	-	-		1.8	1.5	-	-	-	-	
Southeast	0.4	0.9	-	-	-	-		0.1	-	-	-	-	-		0.8	0.1	-	-	-	-	
South	6.4	3.1	0.1	-	-	-		2.3	2.3	1.4	-	-	-		1.8	1.8	0.6	0.1	-	-	
Southwest	18.6	11.8	4.3	1.9	-	-		19.4	15.9	6.4	-	-	-		5.8	28.1	4.4	0.1	-	-	
West	12.7	10.6	0.9	0.1	-	-		21.1	4.2	-	-	-	-		9.0	15.8	2.9	0.3	-	-	
Northwest	2.5	3.0	1.6	0.1	-	-		4.5	4.0	-	-	-	-		6.6	6.6	1.7	-	-	-	
	August 1986							September 1986							October 1986						
	0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20	
North	1.8	4.5	0.3	-	-	-		1.3	3.6	0.7	-	-	-		1.3	2.3	-	-	-	-	
Northeast	5.5	11.8	3.1	-	-	-		1.6	5.9	1.3	-	-	-		3.0	8.4	1.0	-	-	-	
East	3.9	4.9	0.1	-	-	-		0.9	1.7	0.3	-	-	-		1.1	0.4	-	-	-	-	
Southeast	2.5	2.1	0.1	-	-	-		1.4	1.7	-	-	-	-		0.9	-	-	-	-	-	
South	2.1	1.3	0.6	-	-	-		1.4	2.3	0.1	-	-	-		1.4	3.5	2.0	0.4	-	-	
Southwest	4.0	14.5	6.3	1.5	-	-		3.9	19.1	13.3	5.0	1.0	-		10.1	22.2	7.7	1.1	0.1	-	
West	6.7	7.8	1.5	0.1	-	-		8.3	14.6	0.3	0.7	-	-		8.7	11.6	2.2	0.7	-	-	
Northwest	4.9	6.0	0.9	0.1	-	-		4.0	4.4	1.3	0.7	-	-		4.2	4.8	0.6	-	-	-	

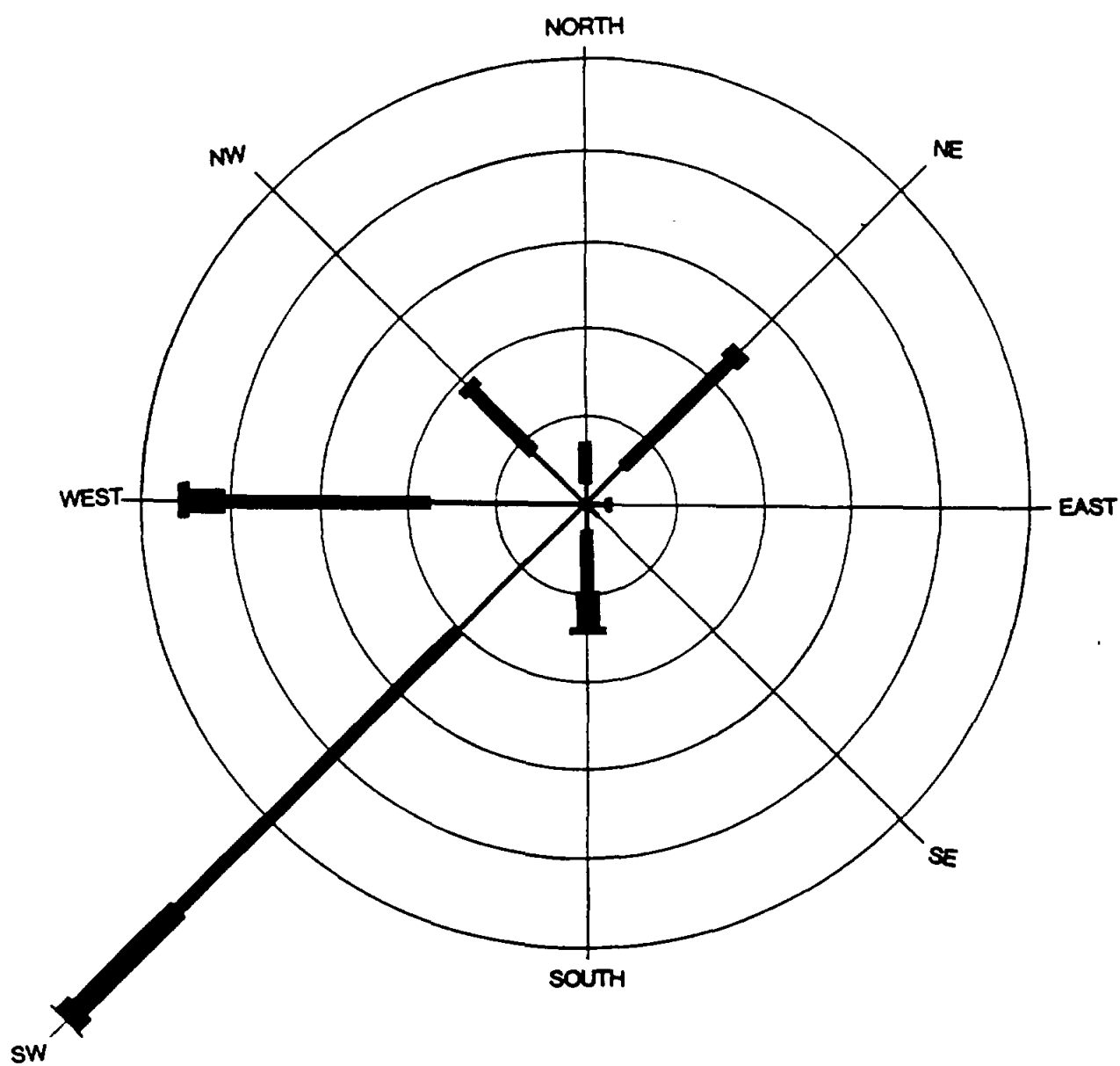
TABLE 2.8-1 (cont.)

	November 1986							December 1986							January 1987						
	0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20	
North	1.5	4.6	0.6	-	-	-		0.7	0.3	-	-	-	-		1.4	4.6	0.8	-	-	-	
Northeast	2.2	9.1	1.8	-	-	-		3.0	5.5	0.9	-	-	-		2.4	9.9	2.4	0.1	-	-	
East	2.2	1.1	-	-	-	-		1.9	0.3	-	-	-	-		0.7	0.8	-	-	-	-	
Southeast	1.8	-	-	-	-	-		0.7	-	-	-	-	-		0.4	0.4	-	-	-	-	
South	1.3	2.8	0.4	-	-	-		2.3	1.6	2.1	-	-	-		1.6	5.2	2.9	0.3	-	-	
Southwest	12.8	13.2	4.2	0.4	-	-		14.9	12.8	6.2	0.9	-	-		7.5	23.9	10.5	3.5	0.3	-	
West	12.4	10.7	2.6	0.1	-	-		18.3	8.5	3.6	0.1	-	-		5.0	9.6	1.8	0.3	-	-	
Northwest	4.9	7.5	1.7	-	-	-		11.0	3.6	0.7	-	-	-		1.9	2.2	1.0	-	-	-	
	February 1987							March 1987							April 1987						
	0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20		0 - 4	5 - 8	9 - 12	13 - 16	17 - 20	>20	
North	0.9	3.5	1.5	-	-	-		0.1	10.7	2.1	-	-	-		0.8	9.2	0.8	-	-	-	
Northeast	1.1	19.6	12.0	0.1	-	-		1.3	16.0	6.7	0.4	-	-		1.3	17.4	9.5	0.1	-	-	
East	1.1	2.1	0.2	-	-	-		1.3	1.7	-	-	-	-		0.7	2.3	-	-	-	-	
Southeast	0.3	0.9	-	-	-	-		0.3	1.5	0.1	-	-	-		0.6	1.1	-	-	-	-	
South	0.4	2.6	-	-	-	-		2.2	2.5	0.6	-	-	-		2.3	2.3	0.1	-	-	-	
Southwest	5.5	8.5	4.1	1.1	-	-		10.7	11.7	2.6	1.7	0.7	-		6.4	11.9	4.5	2.1	1.0	0.1	
West	6.8	12.2	1.9	0.8	-	-		5.6	3.8	1.9	1.5	0.3	-		5.5	6.8	2.1	0.4	-	-	
Northwest	1.1	8.4	2.9	0.4	-	-		0.4	7.9	2.4	0.3	-	-		2.0	7.8	2.0	0.1	-	-	



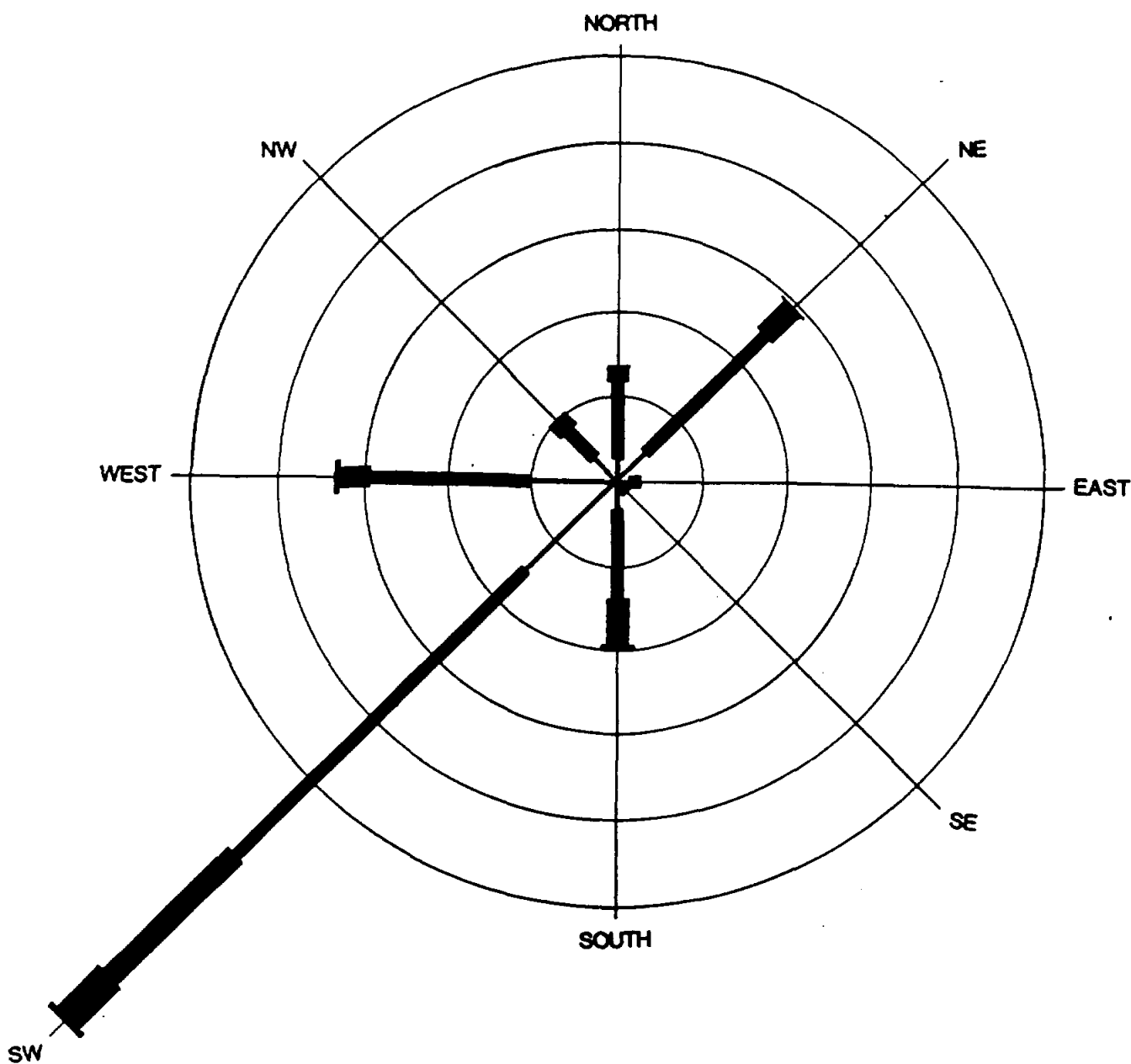
Wind speed categories (MPH) as 0-4, 5-8, 9-12, 13-16, 17-20, >20.
Rings are in 5% increments.

Figure 2.8-2 Wind Rose at Ormet facility for July, 1986.



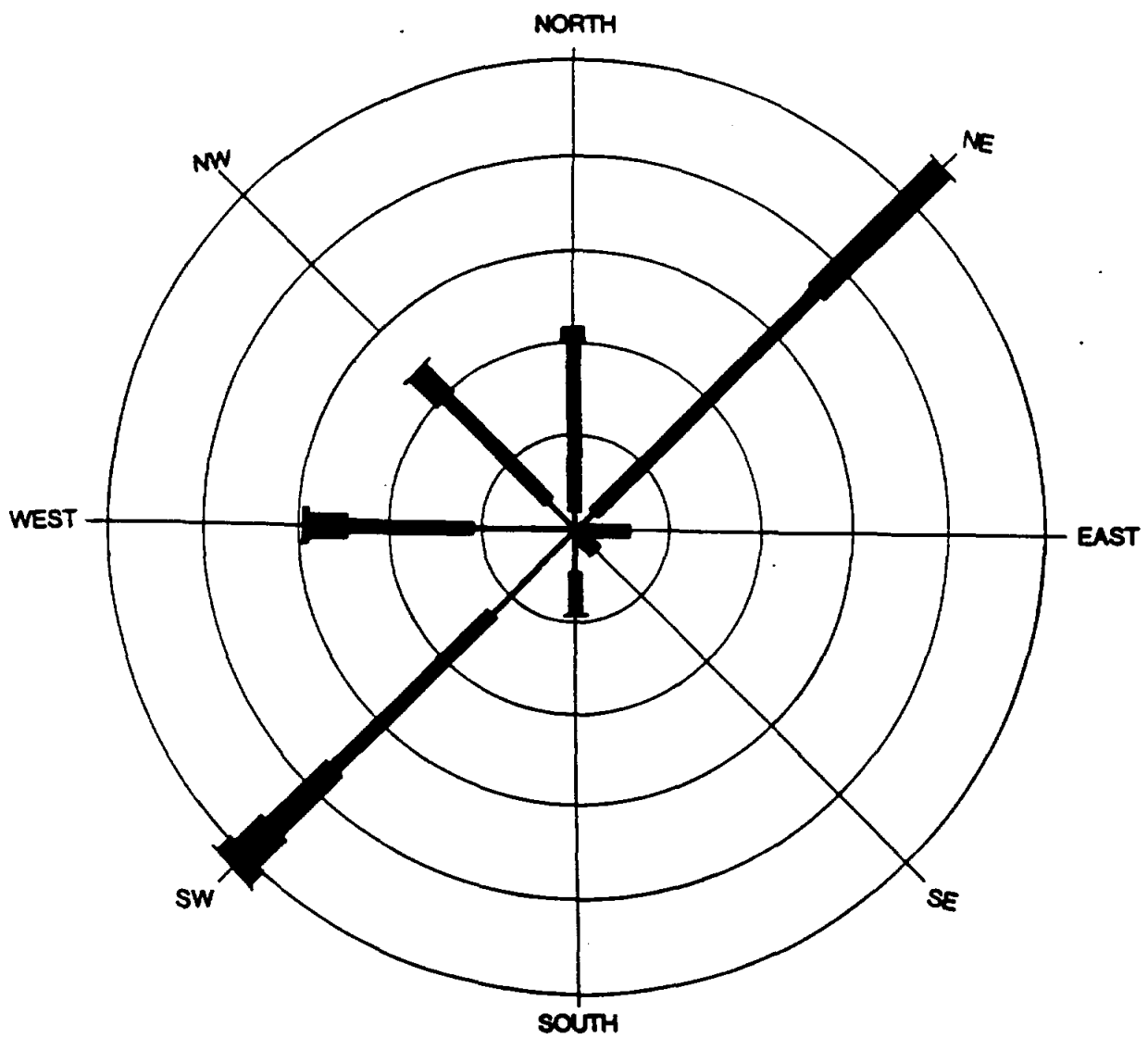
Wind speed categories (MPH) as 0-4, 5-8, 9-12, 13-16, 17-20, >20.
Rings are in 5% increments.

Figure 2.8-3 Wind Rose at Ormet facility for October, 1986.



Wind speed categories (MPH) as 0-4, 5-8, 9-12, 13-16, 17-20, >20.
Rings are in 5% increments.

Figure 2.8-4 Wind Rose at Ormet facility for January, 1987.



Wind speed categories (MPH) as 0-4, 5-8, 9-12, 13-16, 17-20, >20.
Rings are in 5% increments.

Figure 2.8-5 Wind Rose at Ormet facility for April, 1987.

The dominance of southwest and northeast winds near the facility indicates the winds follow the river for a majority of the time. A seasonal pattern is noticeable:

- ° summer winds tend to originate from the southwest, and
- ° winter winds normally originate from the northwest, but because of the orientation of the river at this site, follow the river valley and impact the site from the northeast.

The winds from the west, southwest and northeast directions comprised a total of approximately 73% of the year. Air quality monitors aligned on a southwest to northeast line through the suspected source areas would measure emissions from these areas for almost three-quarters of the study. Monitors to the northeast would measure impacts when winds were from the southwest. Monitors to the southwest would measure impacts when winds were from the northeast. For most of the ten month study, if a monitor is not measuring background concentrations, it will be monitoring impact from the source areas.

2.8.2 Site Selection

Since the prevailing wind direction at the Ormet facility is from the southwest, the prevailing winds pass over virtually the

entire Ormet production facility prior to reaching any of the suspected source areas. Because dust is sometimes generated within the production process, proper placement of the air samplers (both upwind and downwind of the suspected source areas) is very important in order to differentiate plant-generated particulate from any dust emanating from the suspected source areas*.

Based on the analysis of the meteorological data and site inspections of the Ormet facility, four sites have been selected. The location of the four sites is presented in Figure 2.8-6 along with wind roses aligned to magnetic north. Site AM-1 (Air Monitor No. 1) will be located near the northwest corner of the tennis courts which are near the northeast extent of the ponds. Site AM-2 will be located on the levee near the eastern extent of pond No. 5. Site AM-3 will be located approximately 95 feet south of the fenceline corner south of Pond 1. Site AM-4 will be located on the southeast corner of the roof of the construction material storage shed located north of Pond 2.

*The production operations at the Ormet facility include numerous air emission point sources and fugitive dust sources. These sources are regulated by air operationg permits issued by OEPA. These emissions sources are operated within the limits set forth in those permits.

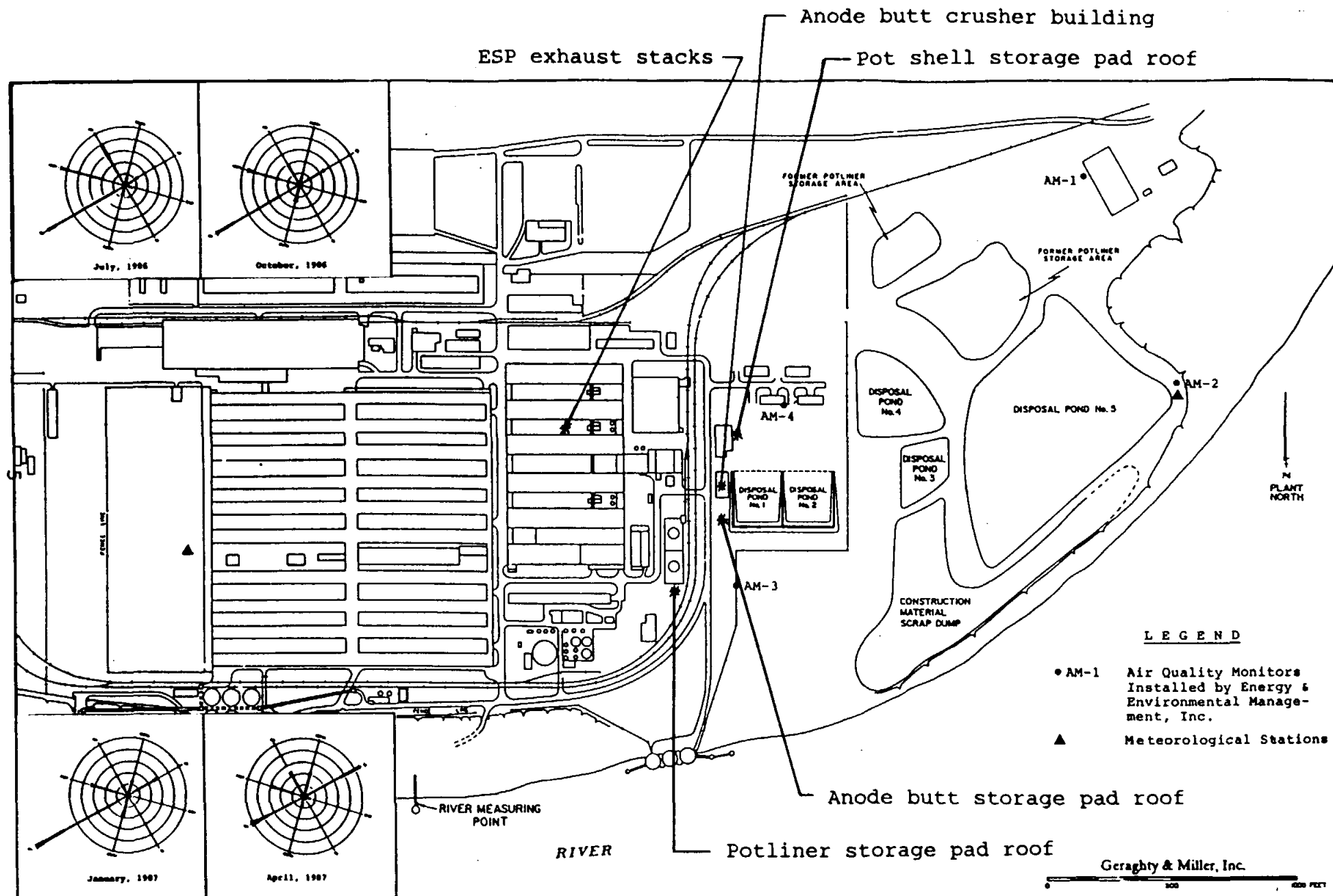


FIGURE 2.8-6 Locations of air quality monitors and meteorological stations at the Ormet facility.

Care has been taken to ensure that the presence of the following structures in the areas adjacent to the AM-3 and AM-4 locations would not violate siting requirements.

<u>STRUCTURE</u>	<u>HEIGHT (in feet)</u>
ESP exhaust stacks	100
Anode butt crusher building	28
Anode butt storage pad roof	35
Pot shell storage pad roof	39
Potliner storage pad roof	31

Site AM-3 and AM-4 will act as background in a majority of the cases due to the southwest winds. AM-4 is expected to be impacted by process fugitive and open dust fugitive emissions to greater extent than AM-3. Impacts at each site will be determined by subtracting a background site. Table 2.8-2 contains a listing of the wind direction arcs for assessing impact at each site. The effect of process fugitives and open dust fugitives are subtracted as part of the background values in Table 2.8-2. This technique is routinely used to reduce the influence of other sources during an impact analysis, thereby providing meaningful data.

2.8.3 Monitoring Program

E²M will conduct the 10 month program to collect 24-hour samples once every 6 days, resulting in a total of 50 samples for each site. E²M will train Ormet personnel to replace the filters

PHASE I REMEDIAL INVESTIGATION
WORK PLAN

3.0 QUALITY ASSURANCE PROJECT PLAN

Section Three

3.0 QUALITY ASSURANCE PROJECT PLAN

PHASE I REMEDIAL INVESTIGATION
ORMET CORPORATION
HANNIBAL, OHIO

REVISION 3
DECEMBER 11, 1987

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LIST OF QAPP REFERENCES

- REFERENCE 1 - ASTM METHOD D3385-75: STANDARD TEST METHOD
FOR INFILTRATION RATE OF SOILS IN FIELD
USING DOUBLE-RING INFILTROMETERS
- REFERENCE 2 - ASTM METHOD D1586-84: STANDARD METHOD FOR
PENETRATION TEST AND SPLIT BARREL SAMPLING
OF SOILS

LIST OF QAPP REFERENCES (CON'T)

- REFERENCE 3 - METHOD FOR FIELD DESCRIPTION OF SOIL SAMPLES
DESCRIPTION AND IDENTIFICATION OF SOILS
- REFERENCE 4 - CALIBRATION AND MAINTENANCE PROCEDURES FOR
FIELD EQUIPMENT
- REFERENCE 4-A - Calibration of MSA Samplair Pump
- REFERENCE 4-B - Calibration, Maintenance and Operation
of Model OVA-128 Portable Organic
Vapor Analyzer
- REFERENCE 4-C - Calibration of Mini-pH Meter
- REFERENCE 4-D - Calibration of YSI Model 33 s-c-t
- REFERENCE 5 - FIELD PRETREATMENT PROCEDURES FOR REMOVAL
OF SULFIDES AND OXIDIZING AGENTS IN AQUEOUS
SAMPLES COLLECTED FOR CYANIDE ANALYSES
- REFERENCE 6 - AIR MONITORING OPERATIONS AND QUALITY
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PHASE I WORK PLAN
REMEDIAL INVESTIGATION
ORMET CORPORATION
HANNIBAL, OHIO

3.0 QUALITY ASSURANCE PROJECT PLAN (SOW TASK 2-A)

3.1 INTRODUCTION

The generation of valid data requires that the factors governing the precision, accuracy, completeness, and representativeness of the data be identified, monitored and documented. Geraghty and Miller, Inc. (G&M) has developed this Quality Assurance Project Plan (QAPP) to ensure that the collection of environmental monitoring data at the Ormet facility meets these requirements. This plan includes the organization of data collection activities, and the associated QA/QC procedures that will be utilized to ensure that all data collected during, and reported by, this study are representative of existing site conditions.

3.2 PROJECT DESCRIPTION

This Remedial Investigation (RI) is being performed to generate additional environmental quality data to determine the nature and extent of any release or threatened release of hazardous substances, pollutants, or contaminants from the Ormet facility. The Phase I RI includes a variety of investigative activities intended to provide a physical and/or chemical characterization of the potential source areas and affected media at the site. These activities address nine general areas:

♦ Ground Water

Sampling of up to 55 ground-water monitoring wells will be performed. All wells will be analyzed for an extensive list of common water quality parameters and major cations and anions, with selected wells also being analyzed for the organic parameters of the U.S. EPA CLP List.

♦ Former Potliner Storage Area

Soil borings shall be performed at 24 locations within the former potliner storage area, with soil samples being submitted for chemical analysis.

♦ Disposal Ponds

Samples will be collected from several designated depths at numerous horizontal locations within each of the old retention ponds. Composite samples will be submitted for chemical analysis. In addition, permeability testing will be performed on each of the pond surfaces and soil borings will be performed around the perimeter of each pond to characterize the underlying soils.

♦ Ohio River Sediments

Sediment samples will be collected from six locations along the river/plant boundary and submitted for laboratory analysis.

♦ Carbon Runoff and Deposition Area

Samples will be collected from three areas of carbon deposition and also from the soils beneath each area and submitted for laboratory analysis. Also, shallow soil samples will be taken and described over a systematic grid in the area where carbon deposits are located so that the lateral extent of the deposits can be determined.

♦ Construction Material Scrap Dump

Two seeps that emanate from the base of the scrap dump will be sampled and analyzed to assess the quality of the leachate.

♦ Plant Recreation Area Fill

The nature of an area of fill that was identified adjacent to the baseball field will be evaluated by sampling and analyzing two seeps that emanate from near the base of the filled area and also by performing soil borings in the area.

♦ Pond 5 Conduit

A steel conduit extending from the southeastern berm of Pond 5 shall be sampled to determine the quality of the effluent, if water is flowing from it at the time of sampling.

♦ Air Monitoring

High volume air samplers will be used at four locations to determine the amount of respirable dust, if any, that may be carried away from the former potliner storage area and the retention ponds by the wind. Samples will be collected periodically over a term of 10 months.

A substantial quantity of background information and data has been generated through previous investigations conducted at the site. A summary of the background information is presented throughout Section 1 of this Plan and additional data is supplied in Appendices A through D.

A description of the site monitoring (sampling) network and the rationale for its design is provided in Section 2, Site Investigation. The data generated through the sampling network will be used to evaluate any actual or potential threat to human health, welfare or the environment. These data will also be used to determine if remedial actions are required and, if necessary, to facilitate screening of possible remedial technologies and alternatives and to develop a cost-effective and technically manageable remedial system for the site.

A summary of the RI Tasks and objectives is provided in Table 3.2-1 and a matrix of field-data collection activities is provided in Table 3.2-2. A listing of the sampling events, with the number of samples to be generated by each and the corresponding types of analyses is provided in Table 3.2-3. In Table 3.2-4, the detection limits for each of the analytical parameters are given. The anticipated schedule for completion of the Phase I data-collection activities is shown in Figure 3.2-1. These field activities will begin upon approval of the Phase I Work Plan by U.S. EPA and OEPA.

TABLE 3.2-1
SUMMARY OF REMEDIAL INVESTIGATION
TASKS AND OBJECTIVES

TASK BREAKDOWN	OBJECTIVES
Work Plan Preparation <ul style="list-style-type: none"> ■ Health and Safety ■ Sampling and Analysis ■ QA/QC 	<ul style="list-style-type: none"> ■ Fulfill EPA and OEPA requirements for RI ■ Ensure representativeness and accuracy of data collected during the RI
Additional Monitoring Wells <ul style="list-style-type: none"> ■ West of Pond 3 ■ ±200' south of MW-12 ■ Southeast of TH-3 	<ul style="list-style-type: none"> ■ Provide additional ground-water monitoring data specifically requested by EPA and OEPA
Ground-Water Sampling <ul style="list-style-type: none"> ■ Analyze all MW-series wells for selected inorganic parameters ■ Analyze selected MW-series wells for complete CLP organics and inorganics 	<ul style="list-style-type: none"> ■ Refine plume delineations ■ Assess plume/source area relationships ■ Evaluate possible impacts, if any, of unconfirmed source areas
Seep Sampling <ul style="list-style-type: none"> ■ Base of construction scrap dump ■ Below plant recreation area ■ Steel conduit at eastern edge of Pond 5 	<ul style="list-style-type: none"> ■ Evaluate possible impacts, if any, of unconfirmed source areas
Disposal Pond Characterization <ul style="list-style-type: none"> ■ Composite pond solids sample analyses ■ Pond perimeter soil borings ■ Double-ring infiltrometer testing 	<ul style="list-style-type: none"> ■ Provide additional data specifically requested by EPA and OEPA ■ Further characterize chemical make-up of pond solids ■ Assess vertical and lateral variations in pond solids composition ■ Evaluate physical characteristics of soils beneath ponds ■ Determine permeability of pond surfaces

TASK BREAKDOWN**OBJECTIVES****Former Potliner Storage Area Characterization**

- Approximately 24 soil borings with continuous sampling
 - 5 composite samples from each boring analyzed for indicator inorganics
 - Selected samples analyzed for complete CLP organics and inorganics
- Characterize the presence in soils of residual potliner material
 - Determine lateral and vertical extent of affected soils

Characterization of Ohio River Sediments

- Six samples to be analyzed for complete CLP organics and inorganics
- Assess possible facility-related alterations, if any, to Ohio River sediments

Assessment of Carbon Runoff and Deposition area

- Six samples of carbon deposits and six samples of underlying soils analyzed for CLP organics and inorganics
 - Hand borings performed over 50-foot square grid
- Evaluate possible impacts, if any, of unconfirmed source area
 - Determine lateral and vertical extent of deposition area

Plant Recreation Area Fill Investigation

- Soil borings with continuous sampling
 - Visual inspection and logging of soil composition
- Determine if source material is present

Air Monitoring

- High-volume sampling for total respirable particulates
 - Upwind and downwind samplers
- Provide additional data specifically requested by EPA and OEPA
 - Attempt to quantify volume of respirable particulate if any, transported from suspected source areas by wind

TABLE 3.2-2

MATRIX OF DATA COLLECTION TASKS

Task	Sample/Data Type	Frequency	Objective
Additional Monitoring Wells	- Soil samples	Every five feet of penetration	Characterize soil type and qualitative physical properties
	- Ambient air monitoring	Continuously	Protection of field personnel
Ground-water sampling	- Well-head air monitoring	Prior to sampling each well	Protection of field personnel
	- Field analyses for temperature pH, and specific conductance	Following evacuation of each well	
	- Laboratory Analyses for selected inorganics	All MW-Series wells	Refine plume delineations Serve as baseline data for evaluating remedial system
	- Laboratory analysis for CLP parameters and other selected inorganics	Selected MW-series wells	Evaluate impacts, if any, of unconfirmed source areas
Disposal Pond Characterization	- Ambient air monitoring	Continuously	Protection of field personnel
	- Laboratory analysis of pond solids samples for CLP parameters and other selected inorganics	Composite samples from various depths and lateral locations in each pond	Determine chemical composition of pond solids and assess lateral and vertical variations
	- Double-ring infiltrometer-testing	Selected locations in each pond	Determine permeability of pond surfaces
Former Potliner Storage Area Characterization	- Ambient air monitoring	Continuously	Protection of field personnel
	- Soil samples	Composite sample every 2 feet in 24 borings	Characterize composition type and physical properties
	- Laboratory analyses for inorganic indicators	All composite samples	Assess vertical and horizontal extent of affected soils
	- Laboratory analyses for CLP parameters and other selected inorganics	All samples from 4 selected borings	Further characterization of soil composition
Characterization of Ohio River Sediments	- Laboratory analyses for CLP parameters and other selected inorganics	At six predetermined sampling locations	Assess possible facility-related alterations, if any, to river sediments

TABLE 3.2-2 (continued)
MATRIX OF DATA COLLECTION TASKS

Task	Sample/Data Type	Frequency	Objective
Carbon Runoff and Deposition area Assessment	<ul style="list-style-type: none"> - Soil samples - Laboratory analyses for CLP parameters and other selected inorganics 	<p>Continuously through carbon deposits over 50' x 50' grid</p> <p>On six samples of carbon material and six samples of underlying soil</p>	<p>Assess vertical and lateral extent of carbon deposition</p> <p>Determine chemical composition of carbon deposits</p> <p>Assess alterations, if any, to subsoil conditions</p>
Plant Recreation Area Fill Investigation	<ul style="list-style-type: none"> - Ambient air monitoring - Soil samples - Laboratory analyses of seep samples for CLP parameters and other selected inorganics 	<p>Continuously</p> <p>Continuously</p> <p>From 2 identified seeps</p>	<p>Protection of field personnel</p> <p>Evaluate composition of fill material</p> <p>Assess quality of fluids emanating from beneath fill</p>
Construction Material Scrap Dump Characterization	<ul style="list-style-type: none"> - Laboratory analyses of seep samples for CLP parameters and other selected inorganics 	<p>From 2 identified seeps</p>	<p>Assess quality of fluids emanating from beneath scrap dump material</p>
Air Monitoring	<ul style="list-style-type: none"> - High-volume samples of respirable particulates 	<p>24 hours, once every 6 days for 10 months from each sampling station</p>	<p>Attempt to quantify volume of respirable particulate transported from suspected source areas by wind</p>
Disposal Pond 5 Conduit Sampling	<ul style="list-style-type: none"> - Laboratory analyses for CLP parameters and other selected inorganics 	<p>From steel conduit on east berm</p>	<p>Assess quality of intermittent fluid discharges</p>

TABLE 3.2-3
SUMMARY OF PHASE I SAMPLING AND ANALYSIS PROGRAM

-1-

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLES			REPLICATES			FIELD BLANKS			TRIP BLANKS			MATRIX TOTAL
			NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	
Ground Water	pH	pH	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Specific Conductance	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
	Specific Conductance	Total Dissolved Solids	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Total Organic Carbon	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
	Temperature	Alkalinity	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Ammonia-N	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
	Health & Safety	Chloride	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Fluoride	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
	Air Monitoring *	Sulfate	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Silica (dissolved)	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Cyanide (amenable)	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Cyanide (total)	52-55	1	52-55	5	1	5	9	1	9	---	---	---	66-69
		Tin	32-35	1	32-35	3	1	3	6	1	6	---	---	---	41-44
		CLP Metals	32-35	1	32-35	3	1	3	6	1	6	---	---	---	41-44
		Selected CLP Metals **	20	1	20	2	1	2	3	1	3	---	---	---	25
		Volatile Organic Parameters of the U.S. EPA CLP List	32-35	1	32-35	3	1	3	6	1	6	5	1	5	46-49
		Base Neutral/Acid Extractable Organic Compounds of the U.S. EPA CLP List	32-35	1	32-35	3	1	3	6	1	6	---	---	---	41-44
		Pesticides/PCBs of the U.S. EPA CLP List	32-35	1	32-35	3	1	3	6	1	6	---	---	---	41-44

TABLE 3.2-3
SUMMARY OF PHASE I SAMPLING AND ANALYSIS PROGRAM

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLES			REPLICATES			FIELD BLANKS			TRIP BLANKS			MATRIX TOTAL
			NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	
Disposal Pond Solids	Health & Safety Air Monitoring *	pH	45	1	45	5	1	5	---	---	---	---	---	---	50
		Solids (% by weight)	45	1	45	5	1	5	---	---	---	---	---	---	50
		Total Organic Carbon	45	1	45	5	1	5	---	---	---	---	---	---	50
		Alkalinity	45	1	45	5	1	5	---	---	---	---	---	---	50
		Ammonia-N	45	1	45	5	1	5	---	---	---	---	---	---	50
		Chloride	45	1	45	5	1	5	---	---	---	---	---	---	50
		Fluoride	45	1	45	5	1	5	---	---	---	---	---	---	50
		Sulfate	45	1	45	5	1	5	---	---	---	---	---	---	50
		Silica (SiO2)	45	1	45	5	1	5	---	---	---	---	---	---	50
		Cyanide (amenable)	45	1	45	5	1	5	---	---	---	---	---	---	50
		Cyanide (Total)	45	1	45	5	1	5	---	---	---	---	---	---	50
		Inorganic Parameters of the U.S. EPA CLP List	45	1	45	5	1	5	---	---	---	---	---	---	50
		Volatile Organic Parameters of the U.S. EPA CLP List	45	1	45	5	1	5	---	---	---	---	---	---	50
		Base Neutral/Acid Extractable Compounds of the U.S. EPA CLP List	45	1	45	5	1	5	---	---	---	---	---	---	50
		PCBs	45	1	45	5	1	5	---	---	---	---	---	---	50
Former Potliner Storage Area Soils	Health & Safety Air Monitoring *	pH	120	1	120	12	1	12	---	---	---	---	---	---	132
		Ammonia-N	120	1	120	12	1	12	---	---	---	---	---	---	132
		Calcium	120	1	120	12	1	12	---	---	---	---	---	---	132
		Sodium	120	1	120	12	1	12	---	---	---	---	---	---	132
		Fluoride	120	1	120	12	1	12	---	---	---	---	---	---	132
		Cyanide (total)	120	1	120	12	1	12	---	---	---	---	---	---	132
		Inorganic Parameters of the U.S. EPA CLP List	20-40	1	20-40	2-4	1	2-4	---	---	---	---	---	---	22-44
		Volatile Organic Parameters the U.S. EPA CLP List	20-40	1	20-40	2-4	1	2-4	---	---	---	---	---	---	22-44
		Base Neutral/Acid Extractable Compounds of the U.S. EPA CLP List	20-40	1	20-40	2-4	1	2-4	---	---	---	---	---	---	22-44
		PCBs	20-40	1	20-40	2-4	1	2-4	---	---	---	---	---	---	22-44

TABLE 3.2-3
SUMMARY OF PHASE I SAMPLING AND ANALYSIS PROGRAM
(continued)

-3-

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLES			REPLICATES			FIELD BLANKS			TRIP BLANKS			MATRIX TOTAL
			NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	
River Sediments	Not Applicable	pH	6	1	6	1	1	1	---	---	---	---	---	---	7
		Total Organic Carbon	6	1	6	1	1	1	---	---	---	---	---	---	7
		Alkalinity	6	1	6	1	1	1	---	---	---	---	---	---	7
		Ammonia-N	6	1	6	1	1	1	---	---	---	---	---	---	7
		Silica (dissolved)	6	1	6	1	1	1	---	---	---	---	---	---	7
		Chloride	6	1	6	1	1	1	---	---	---	---	---	---	7
		Fluoride	6	1	6	1	1	1	---	---	---	---	---	---	7
		Sulfate	6	1	6	1	1	1	---	---	---	---	---	---	7
		Cyanide (amenable)	6	1	6	1	1	1	---	---	---	---	---	---	7
		Cyanide (total)	6	1	6	1	1	1	---	---	---	---	---	---	7
		Inorganic Parameters of the U.S. EPA CLP List	6	1	6	1	1	1	---	---	---	---	---	---	7
		Volatile Organic Parameters of the U.S. EPA CLP List	6	1	6	1	1	1	---	---	---	---	---	---	7
		Base Neutral/Acid Extractable Compounds of the U.S. EPA CLP List	6	1	6	1	1	1	---	---	---	---	---	---	7
		PCB (if found in disposal pond solids or former potliner area soils)	6	1	6	1	1	1	---	---	---	---	---	---	7
Carbon Deposition Area Carbon Material	Health & Safety Air Monitoring *	pH	6	1	6	1	1	1	---	---	---	---	---	---	7
		Total Organic Carbon	6	1	6	1	1	1	---	---	---	---	---	---	7
		Alkalinity	6	1	6	1	1	1	---	---	---	---	---	---	7
		Silica (SiO2)	6	1	6	1	1	1	---	---	---	---	---	---	7
		Chloride	6	1	6	1	1	1	---	---	---	---	---	---	7
		Fluoride	6	1	6	1	1	1	---	---	---	---	---	---	7
		Sulfate	6	1	6	1	1	1	---	---	---	---	---	---	7
		Cyanide (amenable)	6	1	6	1	1	1	---	---	---	---	---	---	7
		Cyanide (total)	6	1	6	1	1	1	---	---	---	---	---	---	7
		Inorganic Parameters of the U.S. EPA CLP List	6	1	6	1	1	1	---	---	---	---	---	---	7
		Volatile Organic Parameters of the U.S. EPA CLP List	6	1	6	1	1	1	---	---	---	---	---	---	7
		Base Neutral/Acid Extractable Compounds of the U.S. EPA CLP List	6	1	6	1	1	1	---	---	---	---	---	---	7

[illegible]

TABLE 3.2-3
SUMMARY OF PHASE I SAMPLING AND ANALYSIS PROGRAM
(continued)

Notes: Only those aqueous samples designated for analysis of metals shall be field filtered prior to preservation. Filtration shall be through a glass fiber prefilter.

For aqueous samples, twice the normal sample volume is necessary to perform matrix spike/matrix spike duplicate analyses for volatile organic compounds and three times the normal sample volume is necessary to perform matrix spike/matrix spike duplicate analyses for extractables and pesticides/PCB (where appropriate). Kamron shall provide sample containers that permit collection of adequate sample volumes so that these analyses may be performed.

* Health and safety air monitoring shall be performed for the protection of the field personnel. Data generated by the health and safety air monitoring shall not be used in the evaluation of site conditions for purposes of selecting remedial alternatives.

** List of selected CLP Metals includes:

Aluminum	Cobalt	Nickel
Arsenic	Copper	Potassium
Barium	Iron (total)	Selenium
Cadmium	Lead	Sodium
Calcium	Magnesium	Zinc
Chromium (total)	Manganese	

TABLE 3.2-4

DETECTION LIMITS FOR PARAMETERS
TO BE ANALYZED FOR DURING
PHASE I RI

Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*

Volatiles	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment ^a ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-34-3	5	5
10. 1,2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,2-Dichloropropane	78-87-5	5	5
19. cis-1,3-Dichloropropene	10061-01-5	5	5
20. Trichloroethene	79-01-6	5	5
21. Dibromochloromethane	124-48-1	5	5
22. 1,1,2-Trichloroethane	79-00-5	5	5
23. Benzene	71-43-2	5	5
24. trans-1,3-Dichloropropene	10061-02-6	5	5
25. Bromoform	75-25-2	5	5
26. 4-Methyl-2-pentanone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
28. Tetrachloroethene	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5

(continued)

TABLE 3.2-4
(continued)

Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*

Semivolatiles	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment ^b ug/Kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n- dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600

(continued)

TABLE 3.2-4
(continued)

Volatiles	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment ^a ug/Kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	1330-20-7	5	5

^aMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 3.2-4
(continued)

Semivolatiles	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment ^b ug/Kg
65. Dimethylphthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl-phenylether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octylphthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330

(continued)

TABLE 3.2-4
(continued)

Semivolatiles	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment ^b ug/Kg
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenzo(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

^bMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 3.2-4
(continued)

Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*

Pesticides/PCBs	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment ^c ug/Kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Lindane)	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.0
109. 4,4'-DDE	72-55-9	0.10	16.0
110. Endrin	72-20-8	0.10	16.0
111. Endosulfan II	33213-65-9	0.10	16.0
112. 4,4'-DDD	72-54-8	0.10	16.0
113. Endosulfan sulfate	1031-07-8	0.10	16.0
114. 4,4'-DDT	50-29-3	0.10	16.0
115. Methoxychlor	72-43-5	0.5	80.0
116. Endrin ketone	53494-70-5	0.10	16.0
117. alpha-Chlordane	5103-71-9	0.5	80.0
118. gamma-Chlordane	5103-74-2	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. Aroclor-1016	12674-11-2	0.5	80.0
121. Aroclor-1221	11104-28-2	0.5	80.0
122. Aroclor-1232	11141-16-5	0.5	80.0
123. Aroclor-1242	53469-21-9	0.5	80.0
124. Aroclor-1248	12672-29-6	0.5	80.0
125. Aroclor-1254	11097-69-1	1.0	160.0
126. Aroclor-1260	11096-82-5	1.0	160.0

^cMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation Limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 3.2-4
(continued)

Elements Determined by Inductively Coupled
Plasma Emission or Atomic Absorption Spectroscopy

Element	Contract Required Detection Level (1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

NOTE: These CRDL are the instrument detection limits obtained in pure water. The actual detection limits for samples may be considerably higher depending on the sample matrix.

TABLE 3.2-4
(continued)

DETECTION LIMITS FOR NON-CLP INORGANIC PARAMETERS

	<u>WATER</u> <u>mg/l</u>	<u>SOIL/SLUDGE</u> <u>mg/kg</u>
Alkalinity	1	10
Ammonia, Nitrogen	0.1	1
Calcium	0.01	0.1
Chloride	1	10
Cyanide, Total	0.01	0.1
Dissolved Solids, Total	10	10
Fluoride	0.1	1
Organics Carbon, Total	1	10
Silica	2	20
Sodium	0.002	0.02
Solids, Total	10	10
Sulfate	1	10
Tin	0.005	0.05

These estimated detection limits can fluctuate based upon matrix interferences and sample volume used.

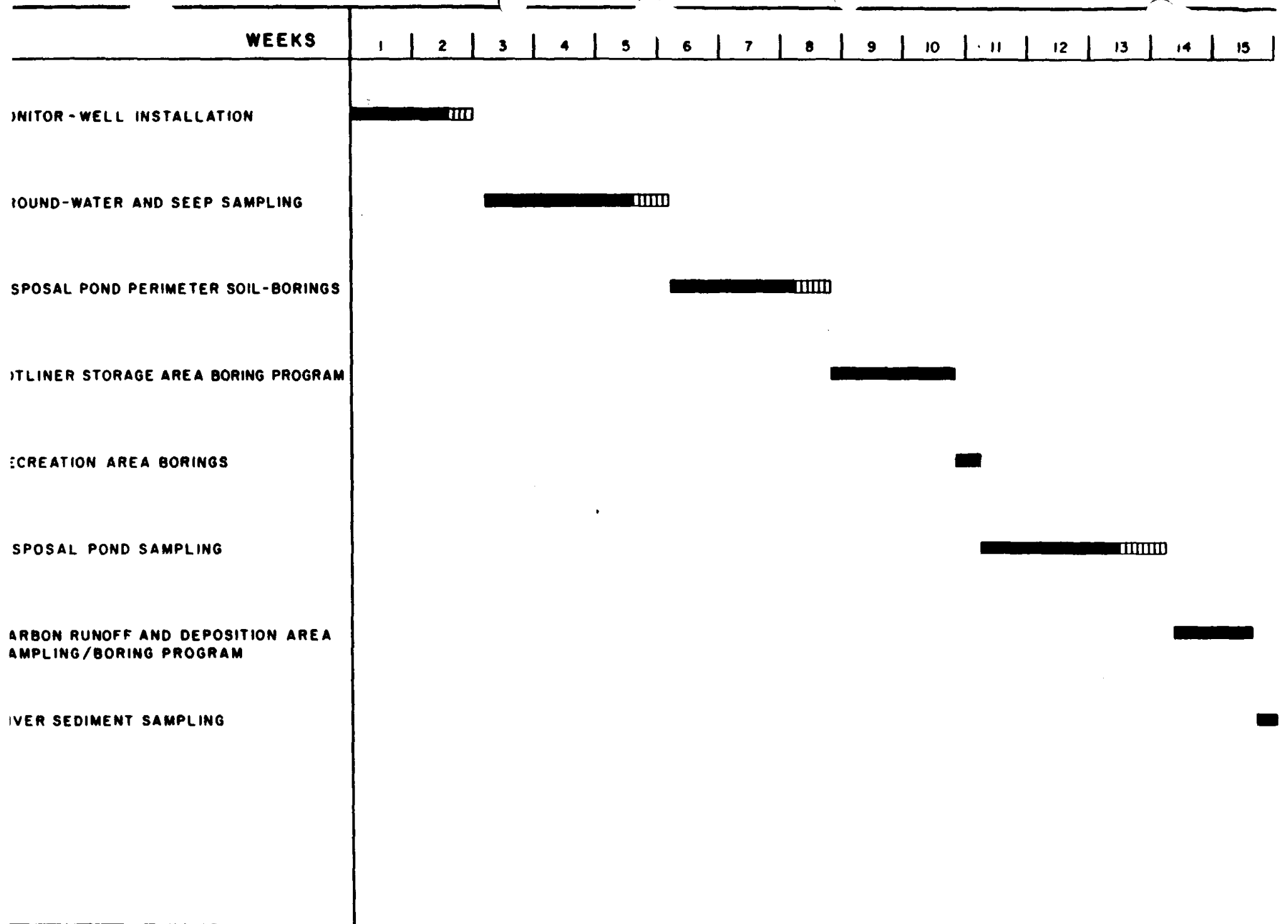


FIGURE 3.2-1 Generalized schedule for performing Phase I RI field activities. Air monitoring activities continue to Phase I and continue for ten months.

Detailed descriptions of the procedures and protocols for conducting the various data-collection tasks of this investigation are presented throughout the following sections of this QAPP. Samples collected for analyses of non-CLP inorganic parameters, as well as organic parameters of the U.S. EPA CLP List will be analyzed by Kemron Environmental Services (Kemron), Marietta, Ohio. Analyses for the inorganic parameters of the U.S. EPA CLP List will be conducted by CompuChem Laboratories, Inc. (CompuChem), Research Triangle Park, North Carolina. The QA/QC Programs for both Kemron and Compuchem are provided in Section 3.9 to this QAPP.

Kemron will be following the procedures required in the CLP Protocol for the tentative identification of unknown compounds. The details are found in Statement of Work Organic Analysis (Multi-media, Multi-Concentration), USEPA Contract Laboratory Program, 10/86, Page A-4, Task V.

The air monitoring program will be performed by Energy and Environmental Management, Inc. of Murrysville, Pennsylvania. The air filters will be sent to Hazen Research, Inc. in Golden, Colorado for weighing.

Halogen compounds

Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

The OVA has negligible response to carbon monoxide and carbon dioxide which evidently, due to their structure, do not product appreciable ions in the detector flame. Thus, other organic materials may be analyzed in the presence of CO and CO₂.

3.3 PROJECT ORGANIZATION AND RESPONSIBILITY

3.3.1 Project Personnel

Ormet has the overall responsibility for the initiation and direction of this RI, and has contracted Geraghty & Miller, Inc. to direct and supervise the tasks required by the Statement of Work. Qualifications of key G&M personnel are provided in Appendix E.

The principal parties involved in the performance of the RI are shown in the organizational chart in Figure 3.3-1. The addresses and phone numbers for the project supervisory personnel are listed below.

Hazardous Waste Enforcement (5HR-11)
Waste Management Division
U.S. Environmental Protection Agency
230 Dearborn Street
Chicago, Illinois 60604
Phone: (312) 886-7242
Rhonda E. McBride
- U.S. EPA Project Coordinator

Ohio EPA
Southeast District Office
2195 Front Street
Logan, Ohio 43138
Phone: (614) 385-8501
Ken Dewey
- OEPA Project Coordinator

Ormet Corporation
P.O. Box 176
Hannibal, Ohio 43931
Phone: (614) 483-1381
John Reggi, Telephone Ext. 2587
- Ormet Project Coordinator
A. Yablonsky, Telephone Ext. 2525
- Ormet Project Liason

Geraghty & Miller, Inc.
429 Washington Trust Building
Washington, Pennsylvania 15301
Phone: (412) 225-8615
Cleason P. Smith
- G&M Project Director
Robert L. Fargo
- G&M Project Manager
Timothy T. Ratvasky
- G&M QA/QC Officer/Site
Safety Officer

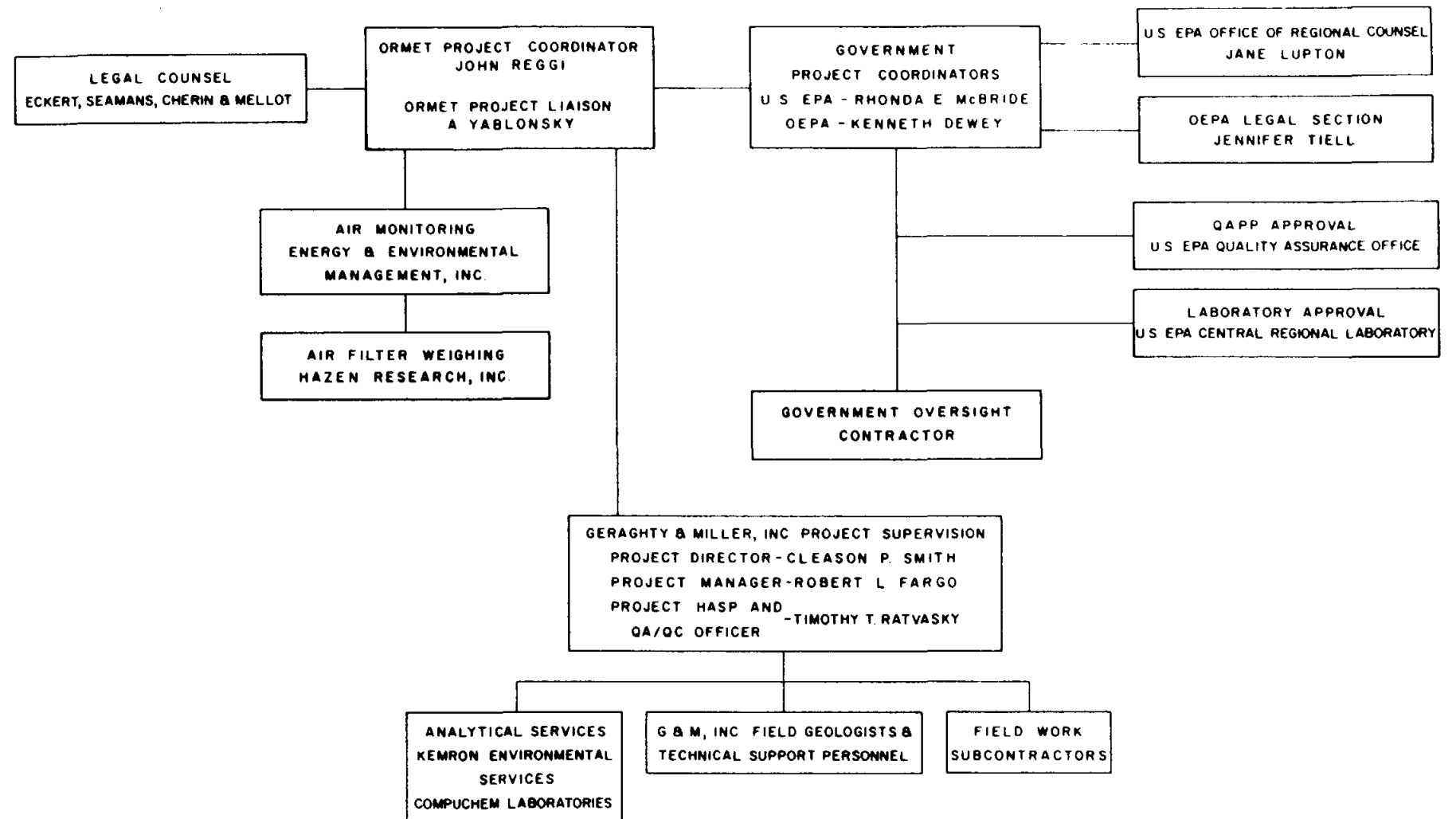


FIGURE 3.3-1. General Organizational Chart for Performance of Phase I RI.

All data generated during the Phase I RI will be reviewed and assessed by the G&M Project Manager and the G&M QA/QC Officer, with final review by the G&M Project Director. Responsibility for all quality assurance/quality control review is with the G&M QA/QC Officer. If quality assurance problems or deficiencies are encountered, the appropriate corrective modifications will be identified with the input of the G&M QA/QC Officer.

Laboratory analytical testing of field samples for organic and non-CLP List inorganic parameters will be performed by Kemron. The QA/QC Coordinator and Project Director for Kemron will be David Bumgarner. The Laboratory Manager is Jean Anderson, with Wayne Wang as the Supervisor of Organics Analyses and Beverly Cornwell as the Supervisor of Inorganics Analyses. Analyses of field samples for the inorganic parameters of the U.S. EPA CLP List will be conducted by CompuChem Laboratories, Inc., a participant of the Contract Laboratory Program. Internal quality assurance procedures to be followed by Kemron and CompuChem are outlined in Section 3.9. The weighing of the air monitor filters will be performed by Hazen Research, Inc.

External performance and system audits of the laboratories supplying analytical services for the Phase I RI shall be conducted by the U.S. EPA Region V Central Regional Laboratory.

3.3.2 Field Organization

The G&M field personnel will be organized according to the activity to be performed. For on-site sampling work, the sampling team make-up will depend upon the type and extent of sampling, but will consist of the appropriate combination of the following:

- G&M Project Manager
- G&M QA/QC Officer
- G&M Site Safety Officer
- G&M Field Geologist(s)
- G&M Technical Support Personnel

The G&M Project Manager, or his designee, will be present during all soil, sediment, and water sampling events and will keep a log describing activities conducted at the site, identifying personnel entering and leaving the work area, and noting general observations regarding site activities.

A G&M Field Geologist will be responsible for supervising the drilling subcontractor during the installation of the monitoring wells and all soil-boring activities. The logging and description of samples collected during the drilling of the monitoring wells and soil borings will be the responsibility of

the G&M Field Geologist. The G&M Field Geologist will also maintain a daily log (Figure 3.3.-2) documenting all on-site activities. The log shall be kept in sufficient detail so that any unusual circumstance that may arise can be reconstructed at a later time.

The G&M QA/QC Officer will be responsible for monitoring all project field activities to ensure adherence to the QA/QC guidelines defined in this QAPP. Periodically (i.e. weekly), the G&M QA/QC Officer shall conduct performance and system audits to assess the adherence to these guidelines. Details of these audits are provided in Section 3.11.

The G&M Site Safety Officer will be responsible for ensuring that all field personnel are familiar with the various aspects of the Site Health and Safety Plan (HASP) prior to going on site. It will also be the responsibility of the Site Safety Officer to modify equipment and procedures based upon new data gathered during the investigation and/or site observations. He will have the authority to stop field operations if circumstances arise that threaten the health or safety of the field personnel.

Well(s) _____ Project/No. _____ Page _____ of _____

Prepared By _____

[illegible]

3.4 QUALITY ASSURANCE OBJECTIVES

The primary quality assurance objective is to make certain that the data generated during the RI is of known and acceptable quality. Data collection efforts will adhere to QA/QC procedures developed by G&M for the collection, preservation, and custody of field samples. Procedures specific to each task of the RI including the collection of quality-control samples (e.g., field blanks, replicates, trip blanks, etc.) are provided in Section 3.10.

The goal for the precision and accuracy assessment process is to produce data of a quality which meets or exceeds the minimum industry (method) standards. The data so generated shall be sufficiently documented to be legally defensible. The goals for accuracy, precision, and completeness are given in more detail in the specific EPA methods of the CLP protocol.

The procedures used to assess the accuracy and precision of the organic analyses include:

- 1) Maintaining records of surrogate spike recovery
- 2) Analysis of laboratory reagent blanks
- 3) Analysis of matrix spikes and matrix spike duplicates
- 4) Monitoring of areas of internal standards
- 5) Initial five point calibration curves
- 6) Continuing calibration compounds (CCC) standards every 12 hours

The procedures to be used in assessing the accuracy and precision of the inorganic analyses include:

- 1) Analysis of a method blank
- 2) Analysis of a reference standard
- 3) Duplicate sample analysis
- 4) Matrix spike analysis

Further details pertaining to the assessment of accuracy, precision, and completeness are provided in Section 3.9.

Specific QA/QC procedures to be followed by Kemron and CompuChem in performing chemical analyses, including quality assurance objectives, are described in Section 3.9. The level of effort for quality-control samples adopted by the laboratories, plus the analytical method, sensitivity, accuracy, and precision, are also provided in Section 3.9.

3.4.1 Precision

The QA/QC aim in testing for precision is to demonstrate the reproducibility of the data. The precision of measurements made during the project will: (a) be evaluated and reported along with the method reference; (b) use high purity materials, standards, solutions, knowledgeable personnel, procedures consistent with scientific practice, and internal quality controls; and (c) be consistent.

3.4.2 Accuracy

Accuracy is the relationship of the reported data to the "true" value. The accuracy of the methods will be evaluated through the use of calibration standards and matrix spikes. Additionally, laboratory accuracy will be assessed through the use of reference samples and evaluated against acceptance standards.

3.4.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement program, compared to the amount that would be expected to be obtained under optimal conditions. The data collected during the RI will be routinely evaluated against the QA/QC guidelines set forth in this QAPP to ensure its validity.

3.4.4 Representativeness

Data obtained should be representative of existing conditions at the sampling location. In evaluating the representativeness of the data, the following factors will be considered:

- the location at which the sample was taken

- the appropriateness of the sampling method to the site-specific conditions
- the appropriateness of the analytical method to the type of sample obtained

3.4.5 Comparability

Comparability will be assessed by utilizing standardized sampling and analysis methods and data reporting formats. The field data will be generated in a manner that will maximize its comparability.

3.5 DATA AND RECORDS MANAGEMENT

3.5.1 Introduction

During the course of this RI, the field data collected will be used to determine if remedial actions are required and, if necessary, to facilitate screening of possible remedial technologies and alternatives to develop a cost-effective and technically managable remedial system for the Ormet facility. The data management procedures outlined in this section are intended to provide for proper inventory, control, storage, and retrieval of data and information collected during the RI. Procedures pertinent to the generation, documentation, and management of data in the field are discussed on a task-specific basis in later sections of this QAPP.

3.5.2 Organization

Project files containing RI-related data, transmittals, and reports generated during the RI will be maintained at the Ormet facility and at the G&M office in Washington, Pennsylvania according to the procedures outlined in this section.

All analytical documentation from the laboratory will be filed with Ormet and G&M. Laboratory documentation will be maintained for purposes of validating data collected during the RI.

3.5.3 Receipt of Data and Reports

All incoming RI-related documents will be stamped with the date received and filed. If distribution is required, the appropriate copies will be made and distributed to project personnel. A listing of personnel intended to receive copies will be attached to the original.

All information generated from RI field activities will be documented on the appropriate forms presented throughout the various sections of this QAPP. These include:

- Soil/Coring Log Form
- Well Construction Log Form
- Water Sampling Log Form
- Daily Log Form
- Drilling and Sampling Daily Checklists
- Copies of Field and Instrument Log Books

The G&M Project Manager, or his designee, will be responsible for recording these documents as they are received.

A log will be kept showing the date received, author/office of origin, and a brief description of the content of the document. Each document will be assigned a document control number according to the following format; R0738H07 - XXXX-YYYY Where:

R0738H07 - is the G&M project number

"XXXX" - refers to the office of origin (e.g., OEPA, EPAV, or ORMT)

"YYYY" - refers to a sequential number assigned to the document

Each originating office will be allotted a separate sequence (e.g., there may be a R0738H07-OEPA-0001 and a R0738H07-EPAV-0001)

3.5.4 Outgoing Data and Reports

All outgoing RI project data and reports will be distributed through Ormet and will be assigned a document control number. The G&M Project Manager will maintain a log of all project documents forwarded by G&M to Ormet.

3.5.5 Telephone and Meeting Notes

Notes from project meetings and telephone conversations will be maintained. These notes will be retained by the author until the conclusion of the project, at which point they will be filed

along with other project documents. An example of the telephone conversation log is shown in Figure 3.5-1.

3.5.6 Document Filing and Access

Project files will be maintained at the Ormet facility and at G&M's Washington, PA office. Files will be organized according to RI task and/or document control number.

Access to the project files will be monitored and limited to project personnel. When a file is removed for review, a sign-out card will be used to track its location.

3.5.7 Computer Data Storage

Laboratory analytical data, water-level data , and other numerical data will be stored and managed using a data management system. Data entry will be performed by designated G&M personnel, and any access to this data base shall be monitored. Computerized data bases will be checked against the original data (maintained in the project file) to ensure that it was entered correctly.

GERAGHTY & MILLER, INC.

QUALITY ASSURANCE PROGRAM

TELEPHONE CONVERSATION

DATE: _____ TIME: _____

FROM: _____ COMPANY/
AFFILIATION _____ Telephone No. _____

TO: _____ COMPANY/
AFFILIATION _____ Telephone No. _____

PROJECT NAME:

SUBJECT:

FIGURE 3.5-1 Telephone conversation log form

3.6. SAMPLING PROCEDURES

Procedures for conducting drilling and soil sampling; monitoring well installation; ground-water and seep sampling; disposal pond, carbon runoff, and river sediment sampling; and air monitoring are described in the following sections of this QAPP. This includes information pertaining to sampling procedures, sample documentation, sample shipping and chain-of-custody, and equipment decontamination. Sample preservation, container, volume, and holding-time requirements for the parameters to be analyzed on water samples are provided in Table 3.6-2. For other sample matrices, this information is given in Table 3.6-3.

Whenever samples are collected for purpose of chemical analysis and placed in a glass container, that sample container shall be sealed in a zip-lock plastic bag. In the event that breakage should occur during shipment, the sample would still be contained within the bag, reducing the potential for cross-contamination. To minimize the possibility of breakage occurring during shipment, the shipping container (supplied by the laboratory) will be of a type that provides individual compartments for each sample container.

3.6.1 Drilling and Monitor-Well Installation

3.6.1.1 Soil Boring Procedures

The soil boring procedures described in this section apply to the borings to be performed during the characterization of the former potliner storage area (Section 2.2), the investigation of the plant recreation area fill materials (Section 2.9), and the installation of the disposal pond perimeter borings (Section 2.1). On a daily basis, the G&M Field Geologist shall maintain a drilling checklist as shown in Figure 3.6-1.

Soil borings to be performed at the Ormet facility shall be advanced via hollow stem auger (HSA) drilling. Soil samples will be collected continuously using a 2-foot-long split-spoon sampling device in accordance with ASTM Method D1586-84, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils," which is provided as Reference 2 at the end of this QAPP.

Upon retrieving each split-spoon sample, the soil core will be removed and inspected and described for gross composition, texture, and other observable properties following standardized G&M procedures. A detailed description of these procedures is given as Reference 3 at the end of this QAPP. The standard form to be used in logging soil sample descriptions is provided in Figure 3.6-2.



DRILLING & INSTALLATION OF MONITORING WELLS DAILY CHECKLIST

PROJECT: _____

WELLS/BORINGS: _____

LOCATION: _____

DATE: _____

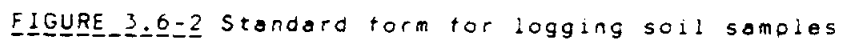
G&M PERSONNEL ON SITE: _____

TIME: _____

CHECKED BY: _____

ITEMS	OK/NA	COMMENTS
PRIOR TO DRILLING:		
Site checked for underground utilities		
Well locations staked		
Well drilling permits secured		
G&M OA Manual/OA plan available		
Health & Safety plan (HASP) available		
Safety equipment on site		
Contractor equipment adequate		
Drilling equipment steam cleaned		
Drilling water source approved/sampled		
Drilling equipment water sample taken		
Drilling mud & additives approved		
Sand or gravel pack sample approved		
Grout composition approved		
DURING INSTALLATION:		
Formation samples properly taken and bottled or bagged		
Rock color chart used		
OVA monitoring during drilling & sampling		
Cores properly marked and stored		
Hard hat worn		
Proper safety procedures followed		
Hazardous soil, mud or water properly disposed		
Daily Log kept		
Sample/Core Log form filled out		
Well Construction Log prepared		
Materials/Cost Log prepared		
Location Sketch made		
Tremie pipe used in grouting		
Abandoned well/boring grouted & staked		
Protective casing/well cap/lock installed		
Well identification no. attached		
Well development adequate		
Well elevation and location surveyed in		
Additional Comments:		

FIGURE 3.6-1 Daily checklist for drilling and monitor-well installation activities



Boring/Well _____ Project/No. _____ Page _____ of _____

Site _____ Drilling _____ Drilling _____
Location _____ Started _____ Completed _____

Total Depth Drilled _____ feet Hole Diameter _____ inches Type of Sample/
Coring Device _____

Length and Diameter
of Coring Device _____ Sampling Interval _____ feet

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used _____ Drilling Method _____

Drilling Contractor _____ Driller _____ Helper _____

Prepared _____ Hammer _____ Hammer _____
By _____ Weight _____ Drop _____ inches

[illegible]

FIGURE 3.6-2 (con't)

In routine sampling programs, a soil composite from each sample will be placed in a glass jar (1/2 pint) with a water-tight lid and labeled to indicate sample location, date of collection, depth interval, blow counts, and the name of the field geologist. This information will also be written on the lid of the sample jar with a waterproof marking pen. Figure 3.6-3 shows the label which will be affixed to each sample jar.

During the characterization of the former potliner storage area, where soil samples will be subjected to laboratory analyses, special sample collection and packaging techniques will be applied. Upon retrieval of the sample from each two-foot interval, the sample will be described as discussed above. Then, the contents of the split-spoon will be placed in a glass container and gently mixed to form a composite. Each of the 120 composites (5 composites from each of 24 borings) shall be split to provide two samples for each interval.

The initial 120 soil samples which are to be analyzed for six inorganic indicator parameters (i.e., calcium, sodium, fluoride, ammonia-nitrogen, pH and total cyanide) will be placed in the appropriate sample containers (see Table 3.6-3) and cooled to approximately 4°C for shipment to the laboratory. Transport of the soil samples will be monitored via chain-of

GERAGHTY & MILLER, INC.

Project # _____
Client Name _____
Boring # _____
Sample # _____
Depth _____
Blows / / /
Recovery _____
Date _____

FIGURE 3.6-3 Standard label to be completed and affixed to soil sample jars.

custody procedures outlined in Section 3.7. The 120 split samples, which are to be held until the results of the original inorganics analyses are received so that 20 samples can be selected for complete CLP List analysis, shall be placed in appropriate containers supplied by the laboratory. These samples shall be properly stored at the selected laboratory. Replicate soil samples shall be prepared and submitted for analysis at a rate of 10 percent. Therefore, 12 replicates will be submitted for analysis of the inorganic indicator parameters and 2 replicates will be submitted for analysis for CLP List parameters.

After each sampling interval, the split-spoon device will undergo a multi-step washdown to reduce the risk of cross-contaminating samples. First, the split spoon will be brushed with a dry brush to remove the bulk of any remaining soil. This residual soil from the split spoon will be distributed on the ground in the immediate vicinity of the boring from which the sample is collected. The spoon will then be washed in a solution of Sparkleen soap, followed by a rinse in clean tap water, then a distilled water rinse. The Sparkleen soap wash water and the rinse water, which will be collected in a bucket beneath each rinse spigot, shall be placed in the same container used to collect the drilling rig washdown water after each boring.

Following completion of each soil boring, the borehole shall be backfilled with thick bentonite slurry to within approximately two (2) feet of land surface. The slurry will be mixed as thick as can be circulated through the mixing pump. This produces a slurry that is generally thick enough to reduce migration into the unsaturated zone. A tremmie pipe will be used to install the slurry, allowing the borehole to be backfilled from the bottom up. This reduces the potential for creating void spaces in the column of bentonite. The remaining upper 2 feet will be filled up to ground surface with neat cement. The boring location will be marked with a wooden stake inserted into the cement. The stake will be marked to indicate the boring number, total depth, and date.

Each boring will be surveyed by a licensed surveyor to determine its map coordinates to within ± 3 feet. Elevations of the ground surface (i.e., the top of the cement surface plug) at each boring will be surveyed to within ± 0.10 -foot accuracy to facilitate stratigraphic correlation and cross-section preparation.

3.6.1.2 Monitor-Well Installation/Construction/Development Procedures

Additional ground-water monitoring wells will be installed at the three general locations shown in Figure 2.5-1. If the saturated interval is found to exceed 20 feet in thickness at any of the proposed locations, a two-well cluster will be installed to provide zone-specific monitoring of the upper and lower portions of the aquifer (i.e., maximum length of well screens will not exceed 20 feet).

Twenty-foot well screens are specified because they provide for reliable detection of dissolved ground-water constituents, are consistent with other monitor wells recently installed at the site, and (whether single or two-well clusters) will facilitate screening of the entire saturated thickness of the aquifer, thus ensuring that discrete plumes are not missed.

The monitor-well boreholes will be advanced to bedrock (as determined by split-spoon refusal) using 4 1/4-inch-I.D. hollow stem auger (HSA) drilling. Split-spoon samples will be collected at regular 5-foot intervals in accordance with procedures outlined in Section 3.6.1.

If drilling fluids are needed during the drilling operations (e.g., to control running sands, to thin suspended sediments within the augers that tend to "float" the well assemblies, etc.), clean water will be used. Prior to implementation of the field program, a sample will be collected from the drilling water source and submitted for analyses of those parameters given in Tables 2.6-1 and 2.6-2). In addition, the water source will be sampled every four weeks during the field program. These samples shall be refrigerated until the completion of Phase I, so that additional analyses may be performed if deemed necessary.

Monitoring well assemblies consisting of 2 inch-diameter factory slotted PVC screen (.010-slot) and casing will be inserted through the inner bore of the HSA flytes (general well construction details are given in Figure 3.6-4). All joints will be threaded flush-joint and Teflon taped. After the well assembly is inserted, the augers shall be pulled back to approximately four (4) feet above the top of the well screen to permit collapse of natural aquifer materials, which at the Ormet site, consist predominantly of sand and gravel. Natural formation materials having suitable texture (i.e., sand and gravel) are preferred as a sand pack because their use can reduce

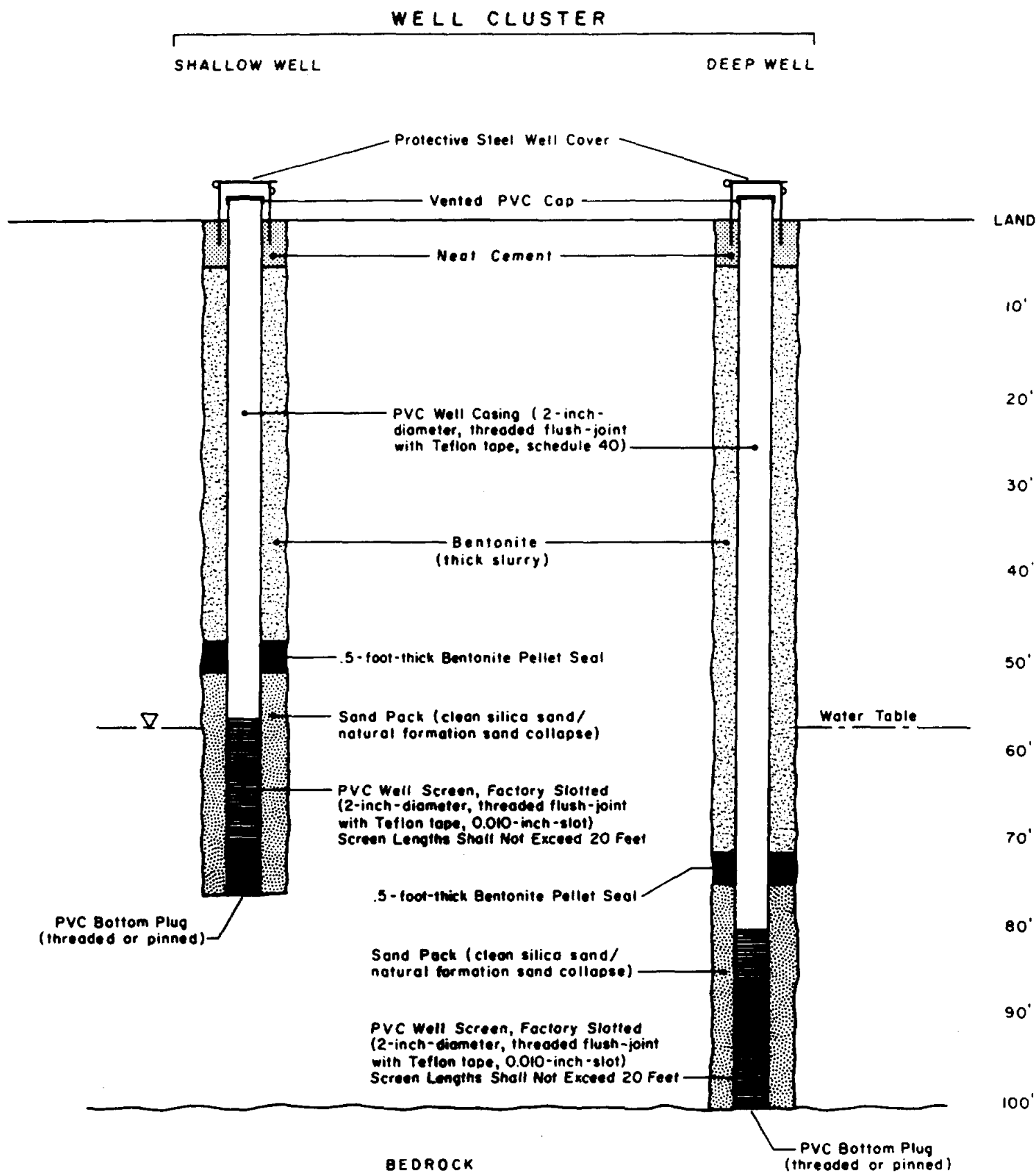


FIGURE 3.6-4 Generalized well construction diagram for additional monitoring wells to be installed during Phase I RI.

or eliminate the need to add foreign materials (i.e., artificial sand pack) to the borehole. This reduces the chance for introducing extraneous dissolved constituents to the ground water and can increase the representativeness of analytical data. Collapse of the natural sand and gravel formation will be determined by measuring through the auger annulus with a steel tape.

At locations where there is only partial collapse of sand and gravel formation materials, clean silica sand shall be added to supplement the monitoring well sand pack. If the natural formation contains appreciable quantities of fine material (i.e., silt and clay), clean silica sand shall be used to construct the entire sand pack. This sand shall be placed through the auger flytes and will be installed to a level approximately 4 feet above the top of the well screen. The silica sand is predominantly quartz and is described by the supplier as a 4 x 30 mix. A sieve analysis of the sand to be used is given in Table 3.6-1. Considering that the aquifer formation beneath the site is predominantly quartz sand and gravel and commonly exhibits a grain size that is similar to that of the silica sand (based on numerous soil samples collected during previous investigations), the artificial sand pack is compatible with the aquifer formation.

TABLE 3.6-1
SIEVE ANALYSIS DATA FOR SAND PACK MATERIAL
ORMET CORPORATION
HANNIBAL, OHIO

STANDARD SIEVE SIZE	DIAMETER (inches)	%RETAINED
4	0.187	12
6	0.132	52
8	0.094	29
10	0.079	3
12	0.066	2
16	0.047	1
20	0.033	0
30	0.023	0
40	0.017	0
50	0.012	0

Upon completion of the sand packing operation, bentonite pellets will be installed through the augers to form a seal approximately one-half (1/2) foot thick on top of the sand pack. A thick bentonite slurry will then be installed through the augers to a level approximately 4 to 5 feet below ground surface. In this procedure, the augers (resting on top of the bentonite pellet seal) will be filled with the bentonite slurry via a tremmie pipe. As the augers are removed, bentonite will fill the void behind the augers. At locations where the consistency of the upper deposits maintains the integrity of the borehole, all of the augers may be pulled prior to installing the bentonite slurry. In such cases, the slurry will again be tremmied into the borehole to avoid the potential for creating voids or cavities within the borehole seal. Where the bentonite pellets are installed below the water table, hydration will occur upon placement. If circumstances result in a pellet seal being installed just above the water table (e.g., in the shallow well of a well cluster), the bentonite slurry tremmied on top of the pellets will act to hydrate them.

The remaining upper 4-5 feet of the borehole shall be filled with neat cement up to ground surface and a protective steel casing will be placed over the PVC monitoring well and seated into the cement. The cement mix will be prepared using approximately five gallons of water per 94-pound sack of cement. To facilitate easy location and identification of the wells, the protective casings

will be hand painted (not spray painted) with a brightly colored paint and labeled with the appropriate well number. As each well installation is progressing, the G&M Field Geologist will complete a Well Construction Log, as shown in Figure 3.6-5, to document site-specific well construction data.

It should be noted that cement is not to be used to grout portions of the borehole below the water table, because past experiences have shown that cement can substantially increase the pH of ground water. Since pH is a primary leachate indicator at the Ormet facility, use of cement within saturated deposits (particularly where well clusters are installed) could result in false positive conditions (i.e., elevated pH) which could be misinterpreted as an indication of leachate.

Each well shall be surveyed by a licensed surveyor to determine its map coordinates to within ± 3 feet. Elevations for ground surface and top of PVC casing will be surveyed to within ± 0.01 -foot accuracy to facilitate determination of water-table elevations and preparation of geologic cross-sections.

~~The development of the newly installed monitoring wells shall be performed no sooner than 24 hours after well installation. Development shall be accomplished either by a~~



FIGURE 3.6-5 Standard Form for logging site-specific well construction data.

standard airlift system or via a bladder-type pump. Where a boring is installed using water as the drilling fluid, approximately 3 times the amount of fluid lost while drilling shall be removed. During development, water shall be removed through the entire column of water in the well by periodically raising and lowering the pump intake. Well development shall also include rinsing the interior of the well casing above the water table using later-development water from that well. *

Because no drilling fluids, other than perhaps clean water, are to be used in the monitor-well drilling operation, the primary indicator for determining when the wells are fully developed will be the sediment content of the water. Monitoring wells will be considered fully developed when they produce sediment-free water, to the extent possible. In addition to sediment content, the pH, conductivity, and temperature of the development water will also be monitored at regular intervals to confirm well development. These parameters are considered more important indicators of the degree of well development for wells that have been installed via mud rotary drilling, which utilizes a drilling fluid that can cause alterations to water quality in the immediate vicinity of the borehole.

3.6.1.3 Decontamination of Drilling Rig and Drilling Equipment

The procedures outlined in this section will be applied prior to drilling at each monitor-well location and also prior to performing each of the disposal pond perimeter soil borings and recreation area borings. For the potliner storage area boring program, the complete procedure outlined below will only be followed before starting and again after completing the program. During the program, only the two flytes of augers (i.e., 10 feet) used at each boring location will be steam cleaned, while an already clean set of augers is used to install the next boring.

Prior to each new boring or monitor-well location, the drill rig and associated equipment (e.g., augers drill rods, split spoons, tools, etc.) will be moved to a designated washdown area (see Figure 3.6-5a). The washdown area will consist of a shallow trench that is wide enough to allow a drill rig to be driven into it. The trench will be excavated such that it gently slopes from both ends toward the center and will be lined with heavy mil plastic sheeting. To reduce the risk of puncturing the plastic when the rig is driven into the trench, plywood sheets will be laid on top of the plastic to accommodate the wheels of the rig.

From the low point in the center of the trench, a diversion ditch will be dug, leading to a small collection sump. The diversion trench and the sump will also be lined with heavy plastic, and the sump equipped with a pump.

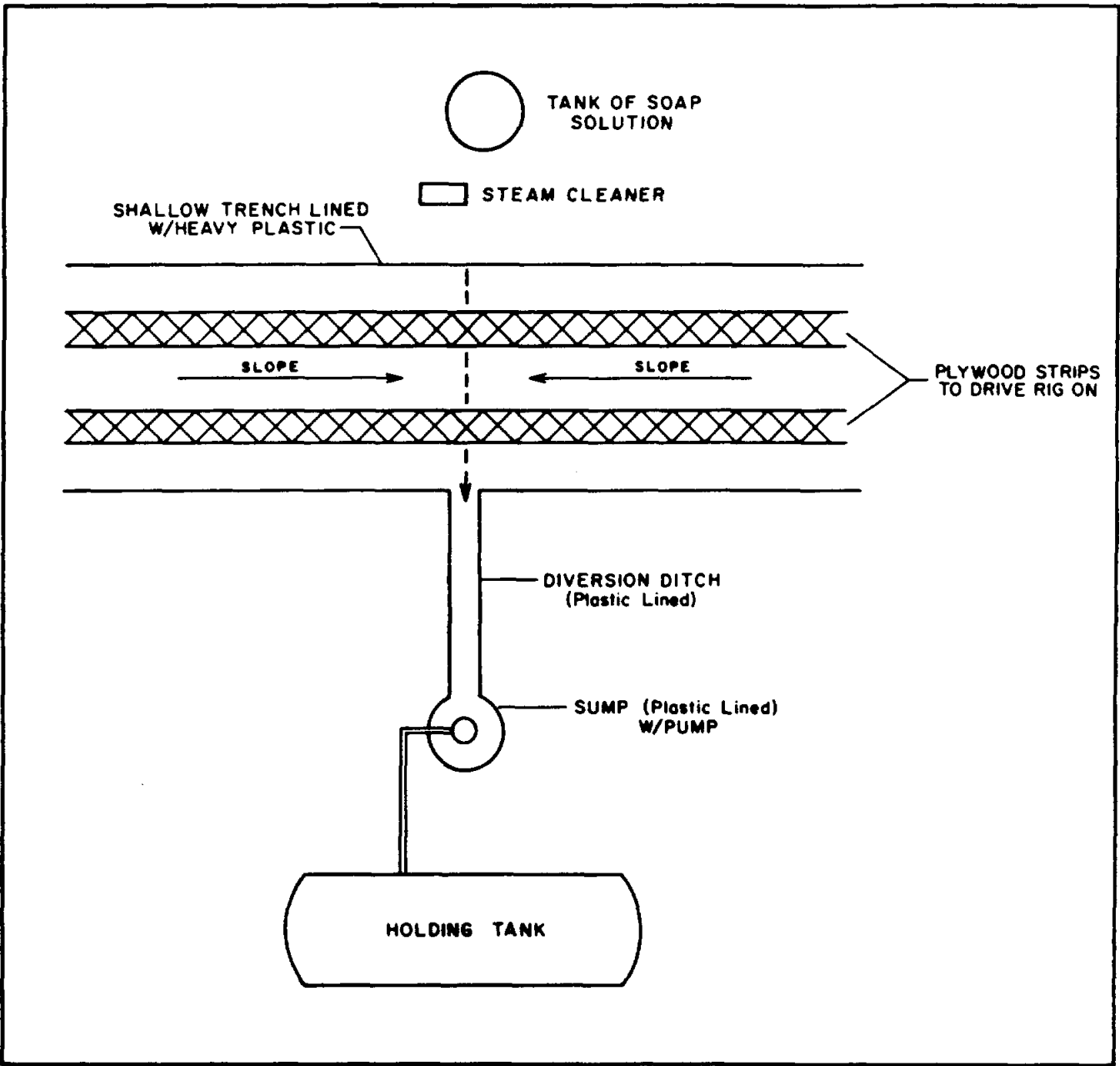


FIGURE 3.6-5a. General diagram of washdown area. Actual design will be dependent upon site-specific conditions.

The decontamination process will require that the rig be driven into the washdown trench and all equipment to be cleaned will be unloaded onto the plastic. A steam cleaner, utilizing a Sparkleen soap solution will be used to wash down the equipment and also the rear of the drilling rig (before leaving the site at the end of the field program, the entire rig will be washed). Sparkleen was chosen because it does not contain ammonia (one of the indicator parameters at the site) and is low in phosphates, but still possesses a surfactant for removing oils and greases. The steam cleaner will then be switched to a clean water source and the equipment and the rig shall be rinsed. The runoff water from the washdown operation will be carried from the trench, through the diversion ditch to the sump, where it will be pumped to a large holding tank. After the field program has concluded, the water in the holding tank will be sampled and analyzed for the inorganic and organic parameters of the U.S. EPA CLP List (excluding PCBs, pesticides, and dioxin) and other selected plant-related indicator parameters. Pending the results of these analyses, appropriate alternatives for the disposal of the washdown water will be developed.

3.6.2 Disposal Pond Sampling Procedures

During Phase I of the RI, solids samples shall be collected from each of the five disposal ponds at the site. Samples will

be collected at a number of horizontal locations in each pond and composited for a variety of predetermined depth intervals according to the sampling scheme detailed in Section 2.1.

Previous disposal pond sampling activities (see Section 1.2.2) have indicated that the upper 2 to 4 feet of material in the ponds is relatively dry and capable of supporting at least moderate weight. Below 2 to 4 feet the consistency of the pond material changes to a saturated oozy sludge.

At each sampling location, the uppermost sample (i.e., at the pond surface) will be collected using a hand-augering device equipped with a three-inch-diameter stainless steel collection barrel. Samples from the deeper sampling intervals shall be collected utilizing ~~the same hand-augering device developed by Geraghty & Miller, Inc.~~ (see Figure 3.6-6). This instrument consists of 5-foot-long sections of 2-inch diameter, threaded flush-joint PVC pipe. To control the intake of sample, a bottom plug is connected to a small-diameter steel rod, which runs through the center of the PVC pipe. By pushing on the steel rod, the bottom plug can be separated from the end of the pipe, opening the device for sample intake, and then pulled back into place. To facilitate sampling at depths greater than five feet, additional five foot lengths of PVC pipe and steel rod can be threaded together. To determine the sample collection depth, the outside of the sampling instrument will be graduated in .5-foot increments.

POND SOLIDS SAMPLING DEVICE

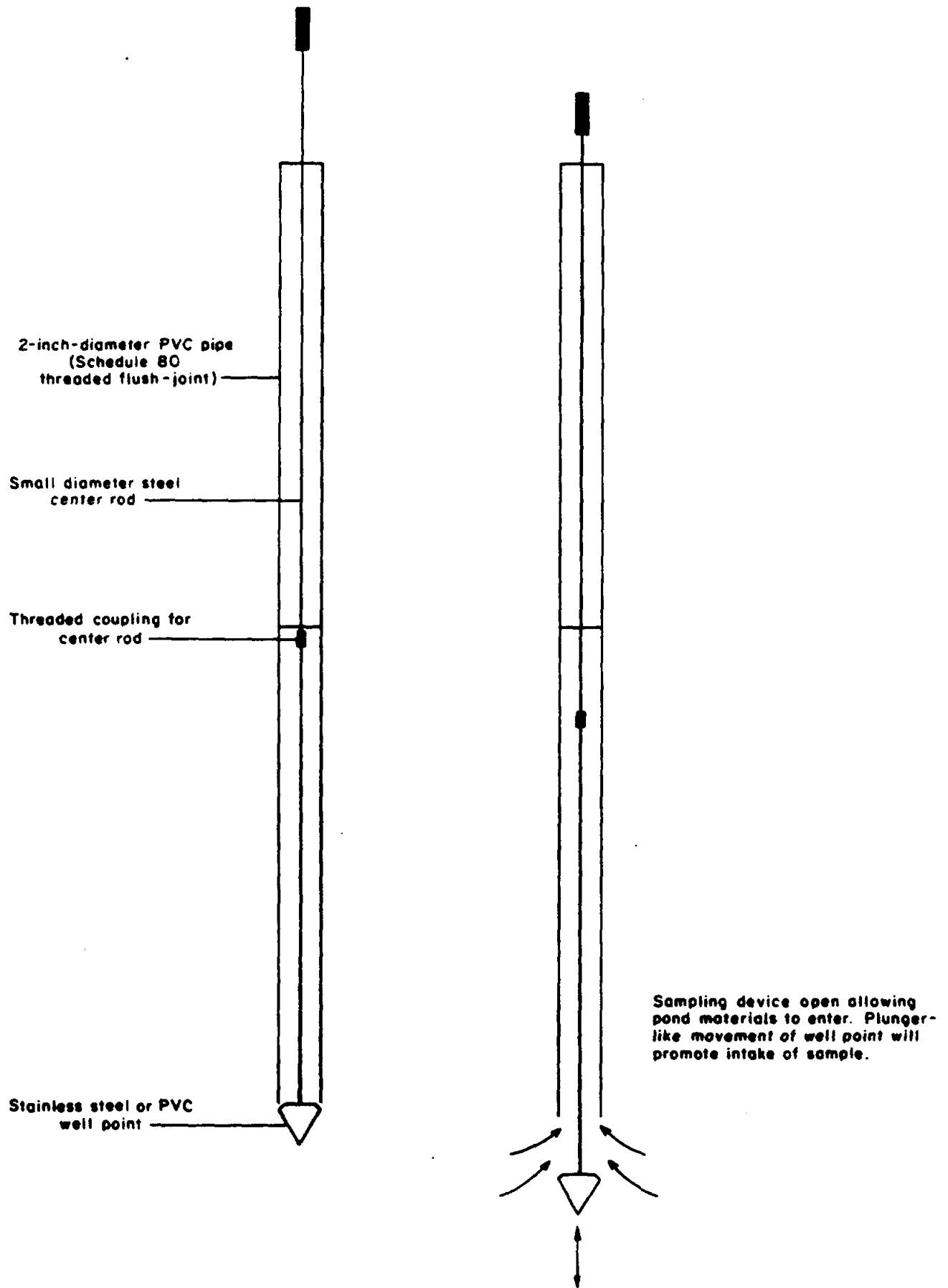


FIGURE 3.6-6 Conceptual design for device to be used in collecting disposal pond samples during Phase I RI.

At each pond sampling location, after the uppermost sample has been collected, the hand-augered borehole will be advanced through the solid upper layer into the oozy sludge. With the bottom plug of the sampling device in the closed position (see Figure 3.6-6), the tube will be pushed to the desired sampling depth, as determined by one foot increments marked on the outside of the instrument. At the selected sampling depth, the bottom plug of the tube will be opened by pushing down on the steel center rod, allowing sludge to flow up into the device (see Figure 3.6-6). To encourage sludge intake into the tube, the steel rod and bottom plug can be worked up and down, with a plunger-like action. The bottom plug of the device will then be closed and the sampling device pulled from the borehole.

In any given pond or pond section, the samples from the pond surface at each designated location will be collected first. The individual samples (approximately one liter each) will be combined in a common glass container which will be kept on ice. After samples from a given sampling interval have been collected, they will be blended slowly to form a composite sample. The blending container will be fitted with an air-tight lid or cover to reduce sample degassing and to prevent possible cross-contamination via airborne particulates. The appropriate sample containers (see Table 3.6-3) will then be filled from the composite.

These composite samples will be subjected to analyses for the parameters provided in Table 2.2.1. Replicate pond solids samples will be prepared and submitted for analyses at a rate of 10 percent (5 replicates will be prepared). Due to the sample matrix, no field blank or trip blank will be prepared.

The composited samples shall be tightly packed into the sample jar in order to minimize air space and the potential for degassing. The sample jars will be labeled to indicate the retention pond number and section, the sample depth interval, the number of individual samples comprising the composite, date, and the names of the sampling personnel. All samples will be held in a cooler chest and cooled to about 4°C following collection. Following completion of sampling, the samples shall be forwarded to the selected laboratory using the chain-of-custody procedures described in Section 3.7 of this QAPP. All unused pond solids shall be returned to the pond or pond section from which they were collected.

One bucket auger, equipped with a stainless steel collection barrel, and up to four sludge sampling instruments will be used during the pond sampling task (i.e., one sludge sampling device shall be assigned for use at each sampling location within a given pond or pond section). The bucket auger will be washed with Sparkleen soap solution and rinsed with clean water between

sampling locations. Following collection of individual sludge samples from a given depth at each location within a pond or pond section, the sample collection devices shall be steam cleaned with a Sparkleen soap solution before being used to gather samples from the next sampling depth. The steam cleaning of the sludge sampling device will be performed at the washdown area described in Section 3.6.1.3. The runoff water resulting from the disposal pond sampling program will be collected in a separate holding tank. This water will then be sampled and analyzed according to Section 3.6.1.3 and an appropriate disposal method selected.

Following completion of sampling activities in each pond or pond section, the sample locations will be marked with a wooden stake driven into the pond surface. The stake will be labeled to indicate the borehole designation (e.g., Pond 5, Section A, #1) and the date. The approximate locations of the sampling locations will be determined by project field personnel using a Brunton compass and 300-foot nylon measuring tape.

To assess the permeability of the disposal pond surfaces, a double ring infiltrometer test will be performed near the center of each pond or pond section. The infiltrometer tests will be conducted according to ASTM Method D 3385-75. This procedure is provided at the end of this section.

3.6.3 Carbon Runoff Area Sampling/Boring Procedures

As outlined in Section 2.7, two samples of carbon material and underlying soil shall be collected from each of three identified deposition areas south of Ponds 1 and 2 (see Figure 2.7-1). Samples shall be collected from a depth just above the contact with underlying soil. This should provide a sample that has been subjected to less extensive leaching than near-surface materials. In order to avoid over coring and possible cross-contamination during the collection of the carbon material and underlying soil, the depth from which the sample is to be collected shall be determined by conducting a preliminary boring to determine the depth to natural soils. The sample of the carbon material and underlying soil will be collected using a hand augering device equipped with a three-inch-diameter collection barrel (stainless steel construction). Prior to collecting each sample, the sampling device shall be cleaned with Micro solution and rinsed with tap water, then with distilled water.

Because sampling of the underlying soil through the same corehole from which the sample of carbon material was collected could potentially cross-contaminate the soil sample, an area several feet across shall be excavated (with a hand shovel) down to and slightly below the contact with the underlying soil. This

is to provide direct access to the underlying soil and should prevent loose carbon material from falling onto the hole from which the sample of the underlying soil is to be collected. The hand auger sampling device will then be cleaned as indicated above and used to advance a borehole until natural soil is encountered that is free of particle carbon that may have migrated downward from the overlying deposits. This determination will be made by the G&M field geologist, based on visual inspection of the soils. The hand auger will then be recleaned and lowered into the pilot hole to collect a soil-sample which will be submitted for laboratory analysis. A conceptual depiction of the sampling procedure is provided in Figure 3.6-7.

It is anticipated, based on previous site investigations, that the soil material beneath the carbon deposits will be a soft to medium-stiff clay. In this type of material, there should be no difficulty in advancing the hand auger to the required sampling depth. If circumstances do arise that require the use of power driven sampling tools, any necessary alterations to the sampling program will be noted in the sampling log and also in the daily log.

The sample of carbon material and the sample of underlying soil shall be placed directly into the appropriate sample containers (see Table 3.6-3) and packed tightly in order to

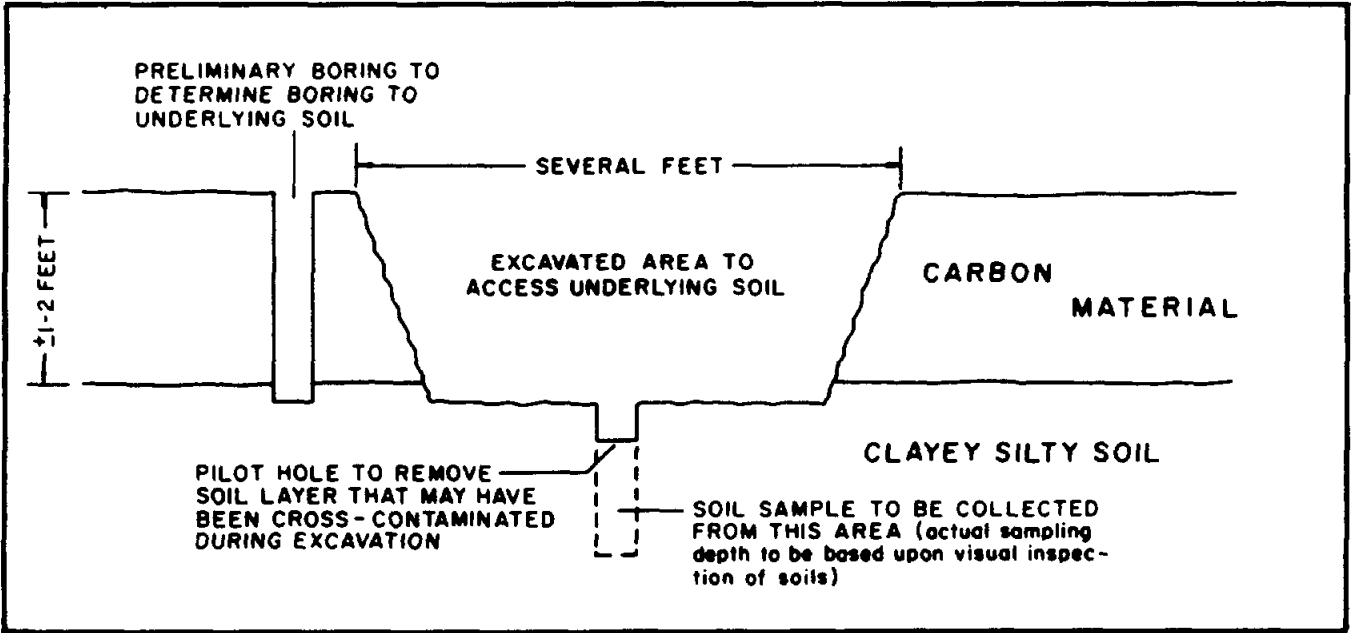
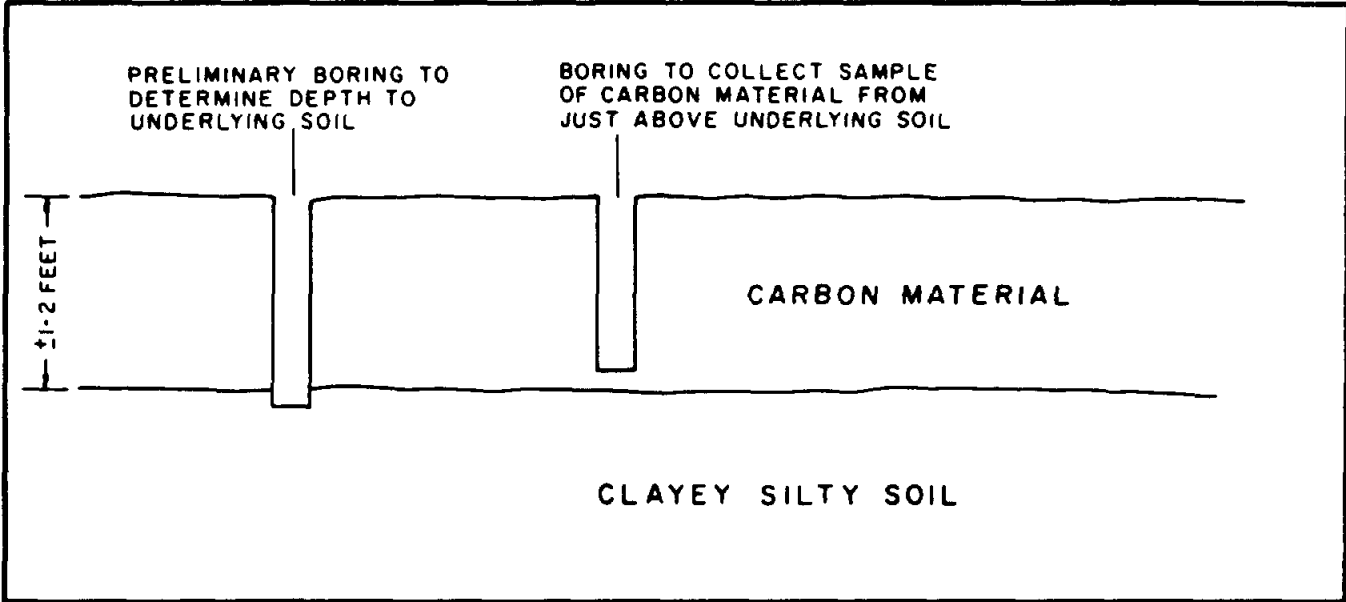


FIGURE 3.6-7. Generalized method to be used in collecting samples from carbon deposition areas and underlying soils.

minimize air space and the potential for degassing. The sample jars shall be labeled to show sample identification number, date, depth of collection, and the name(s) of sampling personnel. The samples shall be kept in a cooler chest and chilled to approximately 4°C following collection. At the time of sampling, a diagram will be prepared to indicate the location from which the sample was taken and a wooden stake will be driven at the sample collection point and labeled with the sample numbers and date of collection. The cored hole into the underlying soil shall then be backfilled with bentonite powder and any excess carbon material removed during the sample collection procedure shall be tamped back into the hand-dug excavation. Following completion of sampling, the samples shall be forwarded to the approved laboratory using the standard chain-of-custody procedures outlined in Section 3.7. One replicate carbon sample and one replicate sample of the underlying soil will be prepared and submitted for analysis. No trip blank for field blank will be utilized.

In addition to collecting samples from the three areas of carbon deposition and the underlying soils, the wooded area where the deposits are located will be gridded off into 50' x 50' sections (see Section 2.7). The grid will be established using a Brunton compass and a 300-foot nylon surveyor's tape.

A shallow hand soil boring shall be advanced approximately six (6) inches into natural soil at the intersection of each grid line. Carbon and soil samples will be inspected and described in the field for gross composition, texture, thickness of carbon material, depth to carbon/soil contact and other observable physical properties in accordance with procedures outlined in Section 3.6.1. A composite sample of the soil material encountered will be retained in a glass sample jar with a water-tight lid. The jar will be labeled to indicate sample depth interval, grid-mark designation, date of collection, and the name of the field geologist (see Section 3.6.1 for standard soil sample handling procedures).

Each of the sampling locations will be marked with a wooden stake identifying the grid-mark designation and the date.

3.6.4 River Sediment Sampling Procedures

According to Section 2.4, samples of the Ohio River sediment are to be collected at six locations as indicated on Figure 2.4-1.

Sediment samples shall be collected from the surface of the sediment to a depth of not more than one (1) foot. This is to obtain a sample most representative of current or near-recent depositional conditions. Sediment samples shall be collected

using a hand augering device equipped with a three-inch-diameter collection barrel (stainless steel construction). Approximately one liter of whole sample (sediment and water) shall be collected at each of the sampling locations. In the event that a large quantity of gravel and/or organic material is collected in the sample, that sample will be discarded and a second sample will be collected several feet from the previous sampling location. The sampling device shall be cleaned with Sparkleen solution and rinsed with tap water, then distilled water prior to sampling at each location.

Each sample shall be placed directly into the appropriate sample jars (see Table 3.6-3), with the sediment being tightly packed into the container in order to minimize air space and the potential for degassing. The sample jar shall be labeled to show sample identification number, date, and the name(s) of sampling personnel. All sediment samples shall be kept in a cooler chest and chilled at approximately 4° C following collection. At the time of sampling, a diagram will be prepared and a marker stake shall be placed on the river bank to indicate the location from which each sample was collected. Following completion of sampling, river-sediment samples shall be forwarded to the selected laboratory using the standard chain-of-custody procedures provided in Section 3.7. One replicate sample of river sediment will be collected and submitted for analysis.

3.6.5 Ground-water Sampling Procedures

During ground-water and seep sampling activities, a monitoring well sampling checklist (Figure 3.6-8) shall be filled out on a daily basis. This form documents various aspects of the sampling procedures which can effect data quality and validity.

Measuring Water Levels

Prior to bailing, purging, and sampling, the static water level in the well will be measured and the volume of standing water in the well must be calculated. Where a number of monitoring wells are to be sampled, a full round of water levels shall be taken prior to starting the water sampling.

The advantages of doing this are: 1) it provides potentially more accurate data for water table maps, relative to measurements collected over a period of days; 2) it allows the sampling team to become oriented to a new site; and 3) it provides the sampling team with immediate information about unusual circumstances such as wells that might be lost, damaged, dry, or inaccessible. If it becomes apparent that a well cannot be sampled, the sampling plan shall be modified accordingly and the G&M Project Manager notified. Any such changes shall be noted in the field log book.



SAMPLING OF MONITORING WELLS DAILY CHECKLIST

PROJECT: _____
 LOCATION: _____
 G&M PERSONNEL ON SITE: _____
 CHECKED BY: _____

WELL(S): _____
 DATE: _____
 TIME: _____

ITEMS	OK/NA	COMMENTS
PRIOR TO SAMPLING:		
Health & safety precautions (HASP) received; equipment ready		
Sample containers, coolers, received from laboratory; ice or ice packs ready		
Sampling equipment and supplies inventoried, clean, and operational		
Checked in with client at site.		
Integrity of well noted		
Well area prepared for sampling; plastic placed around well; gasoline-powered pumps placed downwind.		
Well and water-level measurements made and recorded along with other pertinent field information on water sampling log.		
Field instruments calibrated.		
Sample containers labelled; preservatives added, if necessary.		
DURING AND AFTER SAMPLING:		
Well purged three to five times its volume		
Sample collected using a bailer or pump as per sampling plan.		
Measurement of field parameters recorded on sampling log.		
Sample containers filled according to collection protocol of analyses.		
Field and trip blanks collected; replicates or split samples collected as per sampling plan.		
Samples stored at 4°C in coolers for transport to lab.		
Water sampling log and chain-of-custody form completed.		
Reusable equipment decontaminated; non-reusable equipment disposed of in appropriate manner.		
Well secured and locked.		
Laboratory contacted to confirm receipt and condition of samples		
Additional Comments:		

FIGURE 3,6-8 Daily checklist for conducting ground-water and seep sampling activities

Instructions: Original to Field Project File; copy to Project Manager and to QA

When taking a full round of water-level measurements, care must be taken to avoid cross contamination of wells. When necessary, separate tapes shall be used.

At the Ormet facility, an electric measuring tape (calibrated to 0.05 foot) shall be used for water-level measurements. These measurements shall be recorded in the Water Sampling Log (see Figure 3.6-9). The probe of the electric tape shall be washed with Sparkleen solution and rinsed with distilled water prior to measuring each well. In making each measurement, the probe shall be lowered into the well until the indicator light and/or buzzer signals that water has been reached. The depth to water is then read directly off the calibrated tape at the top of the well casing. Water-level elevation relative to mean sea level is found by subtracting the depth to water from the casing top elevation.

Set-up for Sample Collection

Plastic sheeting shall be placed around the well to protect sampling equipment from potential contamination. The top of the well casing will be cleaned with a clean rag. Sampling in the rain is not encouraged, but may be done if the vehicle can be located near enough and shelter (plastic sheeting) can be

constructed over the sample- handling area to minimize sample exposure. The preliminary information requested in the G&M Water Sampling Log (i.e., project, location, time, date, weather, etc.), shown in Figure 3.6-9 will be recorded at this time.

Purging the Well

Standing water shall be removed from the well casing prior to collecting ground-water samples. Three (3) times the calculated volume of water in the well will be removed to ensure that a representative water sample is obtained from the aquifer. Wells that go dry during evacuation are sampled after recovery. The evacuation rate shall be noted.

The volume of standing water in a well will be calculated by subtracting the depth to water from the total depth of the well and then multiplying this value by a coefficient which relates the diameter of the well to gallons per linear foot. Coefficients for commonly encountered well diameters are listed on the bottom of the G & M Water Sampling Log. The volume of standing water in a well for which a coefficient is not listed can be determined by the formula:

$$V = 7.48 \pi r^2 h$$

where, V = Volume of standing water (gallons)
r = Radius of well casing (ft)
h = Height of standing water (ft)

WATER SAMPLING LOG

Project/No. _____ Page _____ of _____

Site Location _____

Site/Well No. _____ Coded/
Replicate No. _____ Date _____

Weather _____ Time Sampling
Began _____ Time Sampling
Completed _____

EVACUATION DATA

Description of Measuring Point (MP) _____

Height of MP Above/Below Land Surface _____ MP Elevation _____

Total Sounded Depth of Well Below MP _____ Water-Level Elevation _____

Held _____ Depth to Water Below MP _____ Diameter of Casing _____

Wet _____ Water Column in Well _____ Gallons Pumped/Bailed
Prior to Sampling _____

Gallons per Foot _____

Gallons in Well _____ Sampling Pump Intake Setting
(feet below land surface) _____

Evacuation Method _____

SAMPLING DATA/FIELD PARAMETERS

Color _____ Odor _____ Appearance _____ Temperature _____ °F/°C

Other (specific ion; OVA; HNU; etc.) _____

Specific Conductance,
umhos/cm _____ pH _____

Sampling Method and Material _____

Constituents Sampled	Container Description From Lab _____ or G&M _____	Preservative
_____	_____	_____
_____	_____	_____
_____	_____	_____

Remarks _____

Sampling Personnel _____

WELL CASING VOLUMES				
GAL/FT	1-1/4" = 0.077	2" = 0.16	3" = 0.37	4" = 0.85
	1-1/2" = 0.10	2-1/2" = 0.24	3-1/2" = 0.80	6" = 1.48

FIGURE 3.6-9 Standard form for logging field data during water sampling activities

The volume of water purged from the well will be calculated directly by using a container of known volume. The rate of flow, in gallons per minute, will be measured by recording the time (via stopwatch) required to fill the container. The rate and volume of water evacuated from the well will be noted on the Water Sampling Log.

Well evacuations shall be accomplished using a bladder-type submersible pump or Teflon bailer. Gas-operated bladder pumps consist principally of a collapsible membrane inside a long, rigid housing, with a compressed gas supply and appropriate control valve. When the pump is submerged, water enters the collapsible membrane through the bottom check valve. After the membrane has filled, gas pressure is applied to the annular space between the rigid housing and membrane, forcing the water upward through a sampling tube. When the pressure is released, the top check valve prevents the sample from flowing back down the discharge line, and water from the well again enters the pump through the bottom check valve.

Well Sampling Procedure

Well-water samples will be collected using Teflon bottom-filling bailers which will be cleaned immediately prior to use. Cleaning will include washing with Sparkleen solution, a tap water rinse and a distilled water rinse.

For purposes of quality control, we regard the field cleaning of bailers to be preferable to precleaning in a laboratory for three reasons:

1. Contaminants present in the laboratory or wrapping materials may enter the bailer.
2. Residues may be introduced during transit to the site.
3. It is generally not possible for all interested parties to observe laboratory cleaning, wrapping, and transport protocols.

The efficiency of the field cleaning protocols will be monitored by the use of random field blanks, where laboratory pure water will be run through newly cleaned bailers just prior to sampling. Replicate samples comprising about 10 percent of the total sample set shall be collected throughout the sampling program. Trip blanks will be prepared at a rate of one per shipment and field blanks will be prepared at a rate of one per day.

If a well will not yield the volume of water necessary to immediately fill the required number of sample containers, the filled and partially filled containers will be tightly capped, kept out of sunlight and cooled to approximately 4°C, until the necessary volume of samples can be obtained.

Sample Preparation

Once samples have been collected they shall be prepared and held in accordance with the outlined requirements specified in Table 3.6-2. Only those water samples designated for metals analyses requiring acid preservation shall be filtered. This is to remove the suspended material in the sample (e.g., silt and clay), which could be digested by the acid, resulting in elevated levels of those metals that are naturally occurring constituents of the silt and clay. Filtration will be through a fiberglass prefilter prior to being preserved. Because the alluvial aquifer beneath the Ormet facility is relatively permeable, colloids (e.g., silica-related) and other very fine particles are believed to be actually moving with the ground water. Filtration through a 0.45 micron membrane filter could remove some of these constituents, resulting in a less accurate characterization of aquifer conditions. Also, relatively affected ground-water samples (characterized by a dark tea to coffee color) will not readily pass through 0.45 micron membrane filters, and the dilution that can occur as a result of repeatedly changing the filters and rinsing the device could diminish the representativeness of the sample.

Water samples designated for cyanide analysis will be tested in the field for the presence of sulfide and oxidizing agents. If these constituents are detected, they will be removed prior to

TABLE 3.6-2

PARAMETERS TO BE ANALYZED FOR AND LABORATORY METHODS
TO BE USED IN GROUND-WATER AND SEEP ANALYSES

ANALYTICAL PARAMETER	CONTAINER TYPE	PRESERVATIVE (1, 2, 3)	HOLDING TIME MAXIMUM (4)	VOL. ML.	METHOD
Field Temperature	Plastic or Glass	NONE	NONE	---	See Section 3.6.5
Field pH	Plastic or Glass	NONE	NONE	---	See Section 3.6.5
Field Conductivity	Plastic or Glass	NONE	NONE	---	See Section 3.6.5
pH (Lab)	Plastic or Glass	COOL 4° C	6 hrs.	50	EPA 150.1
Conductance (Specific)	Plastic or Glass	COOL 4° C	28 days	100	EPA 120.1
Solids (Dissolved)	Plastic or Glass	COOL 4° C	7 days	100	EPA 160.1
Solids (Suspended)	Plastic or Glass	COOL 4° C	7 days	100	EPA 160.2
Alkalinity	Plastic or Glass	COOL 4° C	14 days	100	EPA 310.1
Silica	Plastic	COOL 4° C	28 days	50	EPA 370.1
Chloride	Plastic or Glass	COOL 4° C	28 days	100	EPA 325.3
Fluoride	Plastic	COOL 4° C	28 days	300	EPA 340.2
Sulfate	Plastic or Glass	COOL 4° C	28 days	50	EPA 375.4
Ammonia-Nitrogen	Plastic or Glass	H ₂ SO ₄ (pH<2)	28 days	400	EPA 350.2
Cyanide (Total)	Plastic or Glass	NaOH (pH>12)	14 days	50	CLP PROTOCOL (5)
Cyanide (Amenable to Chlorination)	Plastic or Glass	NaOH (pH>12)	14 days	50	EPA 335.1
Sodium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	SW846/7770
Potassium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Calcium (by atomic absorption)	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	SW846/7140
Aluminum	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Magnesium (by atomic absorption)	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Iron (total)	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Manganese	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Zinc	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Copper	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Nickel	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Cobalt	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Chromium (total)	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Lead	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Cadmium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Barium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	100	CLP PROTOCOL (5)
Arsenic	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Mercury	Plastic or Glass	HNO ₃ (pH<2)	26 days	100	CLP PROTOCOL (5)
Selenium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Silver	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Antimony	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Beryllium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Thallium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
Tin	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	EPA 282.1
Vanadium	Plastic or Glass	HNO ₃ (pH<2)	6 mos.	50	CLP PROTOCOL (5)
TOC (Total Organic Carbon)	Glass	H ₂ SO ₄ (pH<2)	28 days	10	EPA 415.1

TABLE 3.6-2 (continued)

ANALYTICAL PARAMETER	CONTAINER TYPE	PRESERVATIVE	HOLDING TIME	VOL. ML.	METHOD
		(1, 2, 3)	MAXIMUM (4)		
Volatile Organic Compounds	VOA	COOL 4° C	14 days	40	CLP PROTOCOLS (6)
Semi-Volatile Organic Compounds	Amber Glass	COOL 4° C	7 days	1000	CLP PROTOCOLS (6)
Pesticides and PCB	Amber Glass	COOL 4° C	7 days	2000	CLP PROTOCOLS (6)

Notes for Table 1:

- 1) Unless otherwise specified, all ground-water samples shall be kept cool at about 4° Centigrade (i.e., COOL 4°C), from the time of collection until delivery to the laboratory.
- 2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection.
- 3) When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Material Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 3, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCL) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
- 4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.
- 5) Analyses of CLP inorganic compounds shall be according to EPA SOW No. 786; 10-86 Rev. (IFB 68-01-7329).
- 6) Analyses of CLP organic compounds shall be according to IFB WA-87K236, WA-87K237, and WA-87K238.

TABLE 3.6-3

PACKAGING DETAILS FOR POND SOLIDS, SOILS,
CARBON MATERIAL AND RIVER SEDIMENT SAMPLES

SAMPLE MATRIX	TOTAL CONTAINERS	PARAMETER	CONTAINER TYPE	PRESERVATION	HOLDING TIME	METHOD
Disposal Pond Solids	4-1 pt. plastic	VOA	Amber Glass	Cool 4°C	10 days	***
	6-8 oz. amber glass	Semi-volatiles	Amber Glass	Cool 4°C	10 days/40 days*	***
		Metals	Plastic	Cool 4°C	6 mos.	***
		Cyanide	Plastic	Cool 4°C	14 days	***
		Mercury	Plastic	Cool 4°C	26 days	***
		Other Inorganics	Plastic	Cool 4°C	**	***
Potliner Area Solids	1-1 qt. plastic	VOA	Amber Glass	Cool 4°C	10 days	***
	1-1 qt. amber glass	Semi-volatiles	Amber Glass	Cool 4°C	10 days/40 days*	***
	1-8 oz. amber glass	Metals	Plastic	Cool 4°C	6 mos.	***
		Cyanide	Plastic	Cool 4°C	14 days	***
		Mercury	Plastic	Cool 4°C	26 days	***
		Other Inorganics	Plastic	Cool 4°C	**	***
River Sediments	4-1 qt. plastic	VOA	Amber Glass	Cool 4°C	10 days	***
	6-8 oz. amber glass	Semi-volatiles	Amber Glass	Cool 4°C	10 days/40 days*	***
		Metals	Plastic	Cool 4°C	6 mos.	***
		Cyanide	Plastic	Cool 4°C	14 days	***
		Mercury	Plastic	Cool 4°C	26 days	***
		Other Inorganics	Plastic	Cool 4°C	**	***
Carbon Material	6-1 pt. plastic	VOA	Amber Glass	Cool 4°C	10 days	***
	6-8 oz. amber glass	Semi-volatiles	Amber Glass	Cool 4°C	10 days/40 days*	***
		Metals	Plastic	Cool 4°C	6 mos.	***
		Cyanide	Plastic	Cool 4°C	14 days	***
		Mercury	Plastic	Cool 4°C	26 days	***
		Other Inorganics	Plastic	Cool 4°C	**	***

TABLE 3.6-3 (continued)

PACKAGING DETAILS FOR POND SOLIDS, SOILS,
CARBON MATERIAL AND RIVER SEDIMENT SAMPLES

SAMPLE MATRIX	TOTAL CONTAINERS	PARAMETER	CONTAINER TYPE	PRESERVATION	HOLDING TIME	METHOD
Soils Beneath	6-1 pt. plastic	VOA	Amber Glass	Cool 4°C	10 days	***
Carbon Deposits	6-8 oz. amber glass	Semi-volatiles	Amber Glass	Cool 4°C	10 days/40 days*	***
		Metals	Plastic	Cool 4°C	6 mos.	***
		Cyanide	Plastic	Cool 4°C	14 days	***
		Mercury	Plastic	Cool 4°C	26 days	***
		Other Inorganics	Plastic	Cool 4°C	**	***

* - Semi-volatiles must be extracted within 10 days, analyses must then be performed within an additional 40 days

** - Holding times for non-CLP inorganics in soils, sludges, etc. will be in accordance with holding times for those parameters in water (see Table 3.6-2)

*** - Analyses shall be by approved EPA methods. For CLP organic parameters, analyses shall be according to IFB WA-87K236, WA-87K237, and WA-87K238. Analyses of CLP inorganic parameters shall be according to EPA SOW No. 786; 10-86 Rev. (IFB 68-01-7329).

preservation with sodium hydroxide. The procedures for conducting these field analyses are provided in Reference 5 at the end of this QAPP.

It should be noted that only those samples to be submitted for metals analyses will be filtered. All samples shall be preserved in accordance with the Manual of Ground-Water Sampling Procedures (Scalf and others, 1981) or as otherwise specified by the laboratory selected to perform the water-quality analyses. Preservatives to be used in fixing ground-water samples for the various chemical analyses to be conducted are included in Table 3.6-2.

Following sample preparation, all ground-water samples shall be kept in cooler chests at a temperature of approximately 4°C until they are delivered to the water-testing laboratory. Chain-of-custody procedures and other shipping protocols are further discussed in Section 3.7.

Procedures for Conducting Field Analyses

Measurements for pH, temperature, and specific conductance shall be made in the field at the time of sampling because these chemical properties are difficult to preserve during storage. No holding time is permissible. Approximately one half-gallon of

sample will be placed in a clean, unpreserved glass container when field measurements are conducted. Field measurements will be recorded in the G&M Water Sampling Log (see Figure 3.6.-9).

Temperature:

Temperature will be measured with a rapidly equilibrating, mercury-filled Celsius thermometer, immediately following collection of the sample.

pH:

The pH shall be determined with a glass hydrogen ion electrode compared against a reference electrode of known potential by means of a pH meter or other potential measuring device with a high input impedance. Because pH is exponentially related to concentration, care must be exercised in making a measurement.

Measurement of pH is temperature-sensitive, so the standard buffers should be at a temperature near that of the sample for precise determinations. This can be accomplished by immersing a bottle or test tube containing buffer in the sample discharge.

The pH meter shall be calibrated at the beginning of any sampling day. Calibration is standard two-buffer calibration, following manufacturers' instructions which are included in

Section 3.8. Commonly available buffers have nominal pH values of 4, 7 (sometimes 6.86), and 10. The two buffers that are most likely to bracket the sample pH values shall be used. A one-point calibration (pH 7) will be made each time the unit is moved. Buffer solution shall be decanted from the storage bottle to a small beaker or tube for calibration and then discarded.

Before a measurement is made, the probe is completely rinsed with a stream of deionized or distilled water. Then, to measure pH, the probe is lowered into a container of sample water and allowed to equilibrate. To facilitate equilibration, the probe is used to gently stir the water. (Gentle stirring helps minimize sample aeration.) A pH reading is made as soon as the reading on the meter steadies. Between measurements, the probe will be immersed in deionized water or buffer. At least a one-point calibration shall be performed prior to measuring pH in each sample.

Specific Conductance:

The ability of a solution to conduct an electrical current is a function of the concentration and charge of the ions in solution and the rate at which the ions can move under the influence of an electrical potential. A battery-powered conductivity meter will be used to take the specific conductance measurements. The probe shall be kept clean, and calibrated daily with a conductivity standard, (see Section 3.8).

To measure the sample's specific conductance, the probe will be lowered into the sample and stirred gently. A reading shall be taken within seconds after immersion. Before and after each use, the probe shall be cleaned with a stream of deionized or distilled water.

Recording of Field Data and Labeling of Samples

Field Log Book:

A bound notebook will be used by the field team for recording all sampling events and field observations. Entries in the log book shall be dated and signed by the person making the entry. The log book will be kept in a secure dry place. Entries may not be made in water-soluble ink. The type of information to be included in the log is:

Date
Client
Location
Weather
Sample crew
Work progress
Control samples

Any information that is not normally recorded on the G&M logs and forms should also be included in the Log Book, e.g.,

Delays

Unusual situations

Well damage

Departure from established QA/QC field
procedures

Instrument problems

Accidents

The sampling team shall also maintain the Water Sampling Logs, kept in a ring binder, to record information about each sample collected. The Log will be completed at the time of sampling. It will provide documentation to indicate that sampling requirements have been met. The standard Water Sampling Log is shown in Figure 3.6-9. It includes, in addition to project information and well evacuation data, the following information on sampling:

- Physical appearance of samples
- Field observations

- Results of field analysis
- Sampling methods and materials
- Constituents sampled
- Sample container and preservation
- Sampling personnel

Sample Labels:

Sample labels are necessary to identify and prevent misidentification of the samples. The labels shall be affixed to the sample containers (not the caps) prior to the time of sampling. The labels shall be filled out in pencil at the time of collection. The labels should include the following information:

- Sample number
- Name of collector
- Date and time of collection
- Client and geographic location
- Geraghty & Miller
- G&M project number

After marking, the labels will be covered with clear acetate tape for protection. An example of the sample label to be used is provided in Figure 3.6.-10.



Sample I.D.: _____

Sample Type: ☐ Grab ☐ Composite

Sample Medium: _____

Date: _____ Time: _____

Analysis Requested: _____

Preservative: _____

Sampled By: _____

FIGURE 3.6-10 Standard sample identification label
for use on ground-water and seep sample
containers.

3.6.6 Procedures for Collecting and Packaging Seep Samples

Collection and Packaging Procedures:

Seep samples shall be collected via a standard grab-sampling technique with fluids being collected as close as possible to the points of issuance. Depending upon the occurrence of the seep (i.e., minimal flow across the surface of the ground), it may be necessary to modify this proposed sampling procedure in order to permit efficient sample collection and to obtain the required sample volume. If seep flow is limited to preclude direct grab-sampling, a shoven (properly cleaned with Sparkleen soap and a distilled water rinse) will be used to create a small reservoir to facilitate sample collection. In the event that the reservoir must be left for a period of time to recharge, it will be covered with plastic to prevent possible cross-contamination by airborne particulates. Regardless of the technique used, adequate circulation and outflow shall (to the extent possible) be maintained to avoid stagnation of the water in order to prevent major changes in temperature and/or the possible reaction of certain constituents with prolonged exposure to air and/or sunlight. All tools and materials used in the modification of the seep (if necessary) shall be cleaned with a soap and water wash and a distilled water rinse prior to and after use.

In order to allow any suspended sediments that may result from the seep modification process to settle out, the modified seep shall be left for a period of at least one (1) hour before water samples are collected; assuming that creation of a reservoir is necessary. At the end of this time, a peristaltic pump shall be used to collect the water sample from the holding reservoir. If adequate flow is occurring at the collection point, samples shall be collected directly via the standard grab-sampling technique.

If flow is very limited, a longer period of time may be required to obtain adequate sample volumes. In this case, the filled and partially filled sample containers shall be kept cool approximately (4°C) and out of direct sunlight until an adequate volume of fluid has been collected. Sample filtering and preservation techniques will be similar to those applied to ground-water samples, as outlined in Section 3.6.5. Standard forms for logging water-sampling data and results of field analyses; procedures for conducting field analyses, recording field data, and labeling of samples; and chain-of-custody procedures shall be in general accordance with those outlined in Section 3.6.5 addressing ground-water sampling protocols.

3.6.7 Air Monitoring Procedures

Because several of the Ormet process facilities, which sometimes generate dust, are situated generally upwind from the suspected source areas, the air sampling stations must be properly located so that process-related particulate can be differentiated from airborne dust originating within the suspected source area. The final selection of appropriate locations for the upwind air samplers has been made following completion of the assessment of wind-flow patterns at the Ormet facility, and are shown in Figure 2.8-6.

Ormet has contracted Energy & Environmental Management Inc. (E²M) to conduct the air monitoring program.

Two air samplers shall be installed at locations upwind from the suspected source areas to characterize the amount of respirable particulate (less than 10 micron) present in the wind prior to its passage over the suspected source area; i.e., to characterize back-ground wind conditions. Two additional air samplers will also be established at locations downwind from the suspected source areas in order to assess the amount of respirable wind-borne dust emanating from within these areas.

Twenty four (24) hour samples will be collected from each high-volume type sampler once every six (6) days for ten (10)

months, for a total of 50 samples per sampler. The samples shall be analyzed for amount of respirable dust (PM_{10}) per unit volume air by a qualified independent laboratory, Hazen Research, Inc. of Golden, Colorado.

High-volume samplers manufactured by General Metal Works Corp. retrofitted with General Metal Works Model GMW-1200 PM_{10} Size-Selective Inlets shall be used. Filters shall be GMW-RN-100 Glass Micro-fiber High Purity Filters.

Filters will be removed from the samplers after each sampling period and mailed to Hazen Research for weighing. Pre-weights and post-weights are transmitted by Hazen to E^2M who will calculate the concentration of respirable dust in micrograms per cubic meter of air.

Detailed operations and quality assurance procedures to be followed by E^2M , Ormet, and Hazen Research personnel are included as Reference 6.

3.7 SAMPLE CUSTODY

Sample custody procedures are designed to provide documentation of preparation, handling, storage, and shipping of all samples collected during this project. Samples collected during the site investigation will be the responsibility of identified persons from the time the empty sample containers leave the laboratory, until the collected samples are analyzed.

3.7.1 Sample Container Inventory

Prior to each sampling event, a Sample Container Inventory Form (Figure 3.7-1) along with G & M chain-of-custody seals (Figure 3.7-2) will be forwarded to the laboratory. Using the inventory form, laboratory personnel will prepare a detailed inventory of all empty sample bottles being supplied to the site, including the number of bottles, bottle size, and the preservative (if any), included in each bottle. Each empty sample bottle will be sealed with a G&M seal, showing the signature of the laboratory personnel preparing the bottles for shipment. The inventory form will be signed and dated by the laboratory personnel preparing the shipment and also by the courier transporting the bottles to the site.

Once the shipment is received at the site, a member of the sampling team will sign and date the inventory form acknowledging



Project _____

Shipped to _____

Attn. _____

SHIPMENT CONTENTS

[illegible]

Received by _____

Date _____

Inspected by _____

Date _____

Seal Intact? _____

Remarks:

FIGURE 3.7-1 Standard form for tracking empty sample containers from the laboratory.

CHAIN-OF-CUSTODY SEAL



Geraghty & Miller, Inc.

CHAIN-OF-CUSTODY SEAL

CHAIN-OF-CUSTODY SEAL



Geraghty & Miller, Inc.

CHAIN-OF-CUSTODY SEAL

CHAIN-OF-CUSTODY SEAL



Geraghty & Miller, Inc.

CHAIN-OF-CUSTODY SEAL

CHAIN-OF-CUSTODY SEAL



Geraghty & Miller, Inc.

CHAIN-OF-CUSTODY SEAL

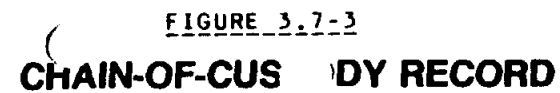
FIGURE 3.7-2 Examples of chain-of-custody seals to be utilized during sample transport to the laboratory

receipt of the shipment. The shipment will then be unpacked and the Sample Container Inventory Form checked against the contents of the shipment. All seals will be inspected to confirm their integrity. Any comments regarding the shipment will be noted and the inventory form signed and dated by the field personnel performing the inspection.

3.7.2 Field Custody

The sampling personnel are personally responsible for the care and custody of the samples collected until they are personally delivered to the analyzing laboratory or entrusted to a courier.

Chain-of-custody sample forms (Figure 3.7-3) will be completed prior to sample shipment. They will include the following information: sample number, time collected, date collected, source of sample, preservative, and name of sampler. These forms will be completed using waterproof ink and signed by the sampler. Similar information will be provided on the sample label, which is securely attached to the sample bottle. Each bottle will be sealed with a G&M custody seal (Figure 3.7-2). One chain-of-custody form will be completed for each shipping container being sent to the laboratory.



Page _____ of _____

SAMPLE IDENTITY	Date Sampled
-----------------	--------------

SAMPLE BOTTLE / CONTAINER DESCRIPTION**TOTAL**Total No. of Bottles/
Containers

Relinquished by: _____ Received by: _____	Organization: _____ Organization: _____	Date ____/____/____ Time _____ Date ____/____/____ Time _____	Seal Intact? Yes No N/A
Relinquished by: _____ Received by: _____	Organization: _____ Organization: _____	Date ____/____/____ Time _____ Date ____/____/____ Time _____	Seal Intact? Yes No N/A

Special Instructions/Remarks:

Delivery method: ☐ In Person ☐ Common Carrier _____ ☐ Lab Courier ☐ Other _____

3.7.3 Transfer of Custody and Shipment

Each sample shipping container will be accompanied by a chain-of-custody record (Figure 3.7-3). The original record will accompany the shipment; and a copy will be retained by the sampling personnel. When transferring samples, the individuals relinquishing and receiving them will sign date, and note the time on the record. This record documents sample custody transfer from the sampler to the laboratory. After being signed by the courier, the field chain-of-custody record will be placed inside the shipping container in a sealed plastic envelope. Given the proximity of Kemron to the Ormet facility, it is anticipated that G & M personnel will deliver the samples directly to the laboratory on a daily basis, or, Kemron will supply a courier from their facility to pick up samples from the site each day. This will eliminate the need to utilize a commercial carrier, thus streamlining the chain-of-custody process.

After collection, samples requiring refrigeration will be promptly cooled to approximately 4°C and packaged in an insulated cooler for transport to the laboratory. Only shipping containers which meet applicable State and Federal Standards for safe shipment will be used. The shipping container will be sealed with at least four G&M custody seals (one on each side), so that any tampering may be detected.

3.7.4 Laboratory Custody

Once at the laboratory, Kemron's sample custodian will note whether or not the custody seals are intact and take custody of the samples by signing the chain-of-custody sheet. All samples will then be logged in and stored in refrigerated space. Kemron maintains its whole facility as a secure facility. All entrances are either locked or under constant surveillance. In addition, all refrigerated storage space is locked at night. Only management and the sample custodian have access to locked refrigerators.

All sample analyses will be completed at Kemron's Marietta facility with the exception of the CLP inorganics. Kemron will forward these samples to CompuChem laboratories in North Carolina for analyses. The chain-of-custody will be maintained throughout this transfer as both Kemron and CompuChem (A CLP lab) are familiar with necessary shipping practices. During this transfer, Federal Express, Inc. will be used and they will also maintain the chain-of-custody.

With respect to shipping, Kemron expects no breakage as both the metals and cyanide will be sampled in plastic containers. These containers will be shipped in KEM-KITS.

Finally, completed chain-of-custody sheets will accompany all sample reports. All shipping, logging, and chain-of-custody documents will accompany the final report as specified by CLP protocol.

3.7.5 Final Evidence File

The final evidence file for the RI shall be maintained by G&M in a secure, limited access area and under custody of the G&M Project Manager. The file shall include all data, logs, field notebooks, pictures, QA/QC audit reports, progress reports, and other relevant records generated during the RI. Specific data records and management procedures to be utilized by G&M, including a description of the document control system, are provided in Section 3.5 of this QAPP. Unless otherwise specified, Kemron shall maintain all laboratory-generated documents for a period of three years after completion of the project.

3.8 CALIBRATION PROCEDURES AND FREQUENCY

A calibration procedure establishes the relationship between a known calibration standard and the measurement of that standard by an instrument or analytical procedure.

Field equipment, including pH and specific conductivity meters organic vapor analyzers (OVA), and MSA Samplair Model A Pump (cyanide vapor monitoring) will be calibrated and operated in accordance with the manufacturers instructions and manuals. Operating and calibration instructions for these instruments are provided in Reference 4 at the end of this Plan. A log book will be kept documenting the calibration results for each field instrument. The log book will include date, standards, personnel, and results of calibration.

Any equipment used to detect unsafe or potentially dangerous conditions for personnel will be calibrated as recommended by the manufacturer. Equipment used to quantitatively measure environmental parameters (e.g., pH and conductivity) will be calibrated at a minimum of once a day by comparison to a commercially prepared calibration standard.

Calibration procedures for laboratory equipment will be performed in accordance with the standard operating procedures for Kemron and CompuChem, which comprise Section 3.9.

3.9 ANALYTICAL SERVICE

Kemron Environmental Services of Marietta, Ohio will perform the analyses for organic compounds, as well as the analyses for non-CLP inorganic compounds. Analyses for the inorganic parameters of the CLP List will be performed by CompuChem Laboratories of Research Triangle Park, North Carolina. The QA/QC procedures and protocols utilized by these laboratories are provided in the following sections.

Kemron will perform the analyses for the CLP organic parameters according to CLP protocols, as specified in IFB WA-87K236, WA-87K237, and WA-87K238. Analyses of all non-CLP parameters will be performed following Kemron's standard operating procedures. Kemron's SOP is provided in Section 3.9.1.

Compuchem will provide analyses for CLP inorganic parameters (metals and cyanide) using CLP protocol as outlined in EPA SOW No. 786; 10-86 Rev. (IFB 68-01-7329).

**3.9.1 Standard Operating Procedures and Analytical Quality
Assurance Program for Kemron Environmental Services**

Analyses for non-CLP inorganic parameters shall be performed according to Kemron's SOP, as presented in the following pages of this section.

Kemron shall perform the analyses for the CLP organic parameters according to CLP protocols, as specified in IFB¹⁰ WA-87K236, WA-87K237, and WA-87K238. These protocols shall take precedence over the procedures outlined in Section 7.2 of Kemron's SOP. Because they are standard EPA approved methods, these procedures are referenced in this plan, rather than included in their entirety.

**3.9.2 Contract Laboratory Program Statement of Work for
CompuChem Laboratories**

Compuchem will provide analyses for CLP inorganic parameters (metals and cyanide) using CLP protocols as outlined in EPA SOW No. 786; 10-86 REV. (IFB 68-01-7329). Because they are standard EPA approved methods, these procedures are referenced in this Plan, rather than included in their entirety.

3.10 QUALITY CONTROL PROCEDURES

3.10.1 Laboratory Quality Control Checks

Procedures for laboratory quality control checks to be utilized by Kemron are documented in Section 3.9.

3.10.2 Field Quality Control Checks

Quality control samples generated by G&M will include the collection of field replicates, the preparation of field blanks, and the use of trip blanks. To assess laboratory performance, replicates will be collected in the field and sent to the analytical laboratory at a frequency of about 10 percent of the sample set. The anticipated number of quality control samples to be generated during Phase I of the RI is summarized in Table 3.10-1

Trip blanks will be shipped along with water samples and will be analyzed at the same time as all other samples. Trip blanks will be utilized at a rate of one sample per shipment.

Field blanks will be prepared using rinse water from the ground-water sampling equipment, and will be analyzed to determine if the sampling procedures may be biasing the data.

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Field blanks will be prepared and submitted at a rate of one per day. Procedures for collecting these samples are discussed in Section 3.6.5.

3.11 PERFORMANCE AND SYSTEM AUDITS

To verify compliance with the stated QA/QC objectives (Section 3.4.), the G&M QA/QC Officer will periodically (e.g., during major sampling events) perform audits of project activities. These audits will consist, where appropriate, of an evaluation of quality assurance/quality control procedures and the effectiveness of their implementation, an evaluation of work areas and activities, and a review of project documentation. Audits will be conducted using the written checklists provided in Figures 3.11-1 and 3.11-2. Results will be documented and reported to the G&M Project Director and G&M Project Manager.

Audits may address the following areas:

- Subcontractor performance
- Field operations and records
- Identification and control of samples
- Numerical analyses
- Transmittal of information
- Document control and retention
- Health and Safety procedures

FIGURE 3.11-1

SYSTEM AUDIT CHECKLIST

PROJECT OFFICE

Project No. : _____

Client: _____

Location _____

Date: _____

YESNOProject Management

- | | | |
|-------|-------|--|
| _____ | _____ | • Were appropriate project personnel selected and do they have adequate skills/training (Health and Safety equipment, etc.)? |
| _____ | _____ | • Was a general project briefing held for participating personnel? |
| _____ | _____ | • Was a task-specific briefing held prior to implementing current field activities? |

Data Management

- | | | |
|-------|-------|--|
| _____ | _____ | • Is the document control system being adhered to? |
| _____ | _____ | • Are all documents accounted for and secure? |

Field Work Set-up

- | | | |
|-------|-------|--|
| _____ | _____ | • Is there a list of accountable field documents? |
| _____ | _____ | • Has coordination been established with contractors and laboratories? |

FIGURE 3.11-1 (cont.)

<u>YES</u>	<u>NO</u>	
		<u>Data Review and Reporting</u>
___	___	• Have data review responsibilities been assigned?
___	___	• Has a data base been established and validated?
___	___	• Have reporting requirements been reviewed?

Comments:

Auditor Name: _____

Auditor Signature: _____

FIGURE 3.11-2

SYSTEM AUDIT CHECKLIST

FIELD OPERATIONS

Project No: _____

Client: _____

Location: _____

Date: _____

Field Personnel:

YESNO

- | | | |
|-------|-------|---|
| _____ | _____ | • Is there a set of accountable field documents checked out to the on-site personnel? |
| _____ | _____ | • Is the Health and Safety Plan being adhered to? |
| _____ | _____ | • Is safety and sampling equipment available and suitable to tasks? |
| _____ | _____ | • Are checklists, log-books, and other field data forms up-to-date and properly filled out? |
| _____ | _____ | • Are field equipment calibration logs maintained and any corrective action noted? |
| _____ | _____ | • Are samples collected according to project plan or per direction of on-site coordinator? |
| _____ | _____ | • Are samples collected in appropriate containers and preserved as specified in Project Plan? |
| _____ | _____ | • Are samples properly identified (labeled)? |
| _____ | _____ | • Are blanks and replicate samples properly identified and documented in log books? |
| _____ | _____ | • Is proper chain-of-custody being maintained? |

Auditing of field operations will include examination of: implementation of approved work procedures; calibration and operation of equipment; labeling, packaging, storage, and shipping of samples; and documentation of subcontractor performance. The records of all field activities shall be reviewed to verify that field-related operations were performed according to appropriate project procedures. Items reviewed will include, but are not limited to: field equipment calibration logs, daily field activity logs, all field data logs, and checklists resulting from field operations.

During an audit and upon its completion, the auditor will discuss the findings with the individuals audited and cite changes to be initiated. Minor deficiencies that can be resolved to the satisfaction of the auditor during an audit are not required to be cited as requiring change. All findings that are not resolved during the course of the audit and that require substantive changes will be noted on the audit checklists.

Following completion of an audit, the auditor will prepare a summary report of findings to be submitted to the G&M Project Director and the G&M Project Manager. This report will serve to notify management of the audit results and may also be sent to individuals contacted during the audit and the management of any affected subcontractor.

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In addition to the performance and system audits to be conducted by G&M, the U.S. EPA Region V Central Regional Laboratory will perform external performance and system audits of the laboratories supplying the analytical services for the Phase I RI.

3.12 PREVENTIVE MAINTENANCE

Preventive maintenance on field equipment will be performed in accordance with procedures supplied by the manufacturer. The manufacturer's operating and maintenance manuals will be kept on site and reviewed by personnel involved in equipment use. Frequent calibration procedures, as outlined in Section 3.8. will be used as a means of determining the need for equipment maintenance.

The maintenance of laboratory equipment will be performed by the laboratory according to specified procedures outlined in Reference 6.

3.13 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

All data generated in this investigation will be assessed for its representativeness, accuracy, and precision. The completeness of the data will be determined by comparing the acquired data to the stated project objectives to see that the objectives are being met. The procedures utilized by the analyzing laboratories to determine data precision, accuracy, and completeness are described in Section 3.9. Additional checks on method precision will be performed using similar methods on field collected replicate samples. Accuracy will be assessed using laboratory spiked samples and laboratory field blanks.

The representativeness of the data will be assessed by first determining if the proper procedures and protocols were followed during the collection of the samples from which the data were generated. Any non-adherence to the procedures and protocols shall be evaluated to determine its potential effect, if any, on the data. Also, the data validation package supplied by the laboratory (as required under the Contract laboratory Program) for each sample analysis will be reviewed to determine if there may be any laboratory-related sources of error in data.

Precision and accuracy will be assessed using QC samples as outlined in Section 3.10. Precision will be examined using replicate samples and accuracy by using blanks and spiked samples. This methodology is summarized in Section 3.9.

3.14 CORRECTIVE ACTION

If the periodic quality-control audits detect unacceptable conditions or data, the G&M Project Director, G&M QA\QC Officer, and G&M Project Manager are responsible for developing and initiating appropriate changes or modifications. The condition or problem will be specifically identified, recorded in the appropriate field log or project file, investigated, and the cause determined. Then, changes or modifications will be initiated to eliminate the problem. These may include:

- Re-analyzing samples if holding time and sample volume permit,
- Resampling and re-analyzing,
- Evaluating and amending sampling and/or analytical procedures,
- Accepting data, while documenting a level of uncertainty.

Upon implementation of changes or modifications, their effectiveness will be established and elimination of the problem verified. Details regarding the changes or modifications implemented and the results will be documented and retained in the project file.

3.15 QA REPORTS TO MANAGEMENT

On a regular basis, the G&M QA/QC Officer will review all aspects of the implementation of this QAPP and prepare a summary report to the G&M Project Manager and G&M Project Director. Reviews will be performed at the completion of each field activity and reports will be completed at this time. These reports will include:

- Assessments of measurement data accuracy, precision, and completeness,
- Results of performance, systems, data, and instrument audits, and
- Any changes or modifications which need to be taken or are to be taken.

Any significant QA problems will be reported and identified, and options for changing or modifying the program can be discussed.

REFERENCES

**STANDARD TEST METHODS AND CALIBRATION/
MAINTENANCE PROCEDURES REFERENCED
IN THE QUALITY ASSURANCE PROJECT PLAN**

REFERENCE 1

ASTM METHOD D3385-75

**STANDARD TEST METHOD FOR INFILTRATION RATE OF
SOILS IN FIELD USING DOUBLE-RING INFILTROMETERS**



Standard Test Method for INFILTRATION RATE OF SOILS IN FIELD USING DOUBLE- RING INFILTRMETERS¹

This standard is issued under the fixed designation D 3385; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

This test method describes a procedure for field measurement of the infiltration rate of soils. Infiltration rate is defined as a soil characteristic determining or describing the maximum rate at which water can enter the soil under specified conditions, including the presence of an excess of water. Infiltration rates have application to such problems as erosion rates, leaching and drainage efficiencies, irrigation, water spreading, rainfall runoff, and evaluation of potential septic-tank disposal fields, among other applications.

Rates determined by ponding of large areas are considered the most reliable method of determining infiltration rate but the high cost makes the infiltrometer-ring method more feasible economically. The infiltration rate is controlled by the least-permeable zone in the subsurface soils. The double-ring infiltrometer is used to help prevent divergent flow in layered soils by providing an outer water barrier to encourage only vertical flow from the inner ring. Many other factors² affect the infiltration rate in addition to the soil structure, for example, the condition of the soil surface, the moisture content of the soil, the chemical and physical nature of the soil and of the applied water, the head of applied water, and the temperature of the water. Thus, tests made at the same site are not likely to give identical results and the rate measured by the procedure described in this test method is primarily for comparative use. Some aspects of the test, such as the length of time the tests should be conducted and the head of water to be applied, must depend upon the experience of the user, the purpose for testing, and the kind of information that is sought.

1. Scope

1.1 This test method describes a procedure for field measurement of the rate of infiltration of water into soils using double-ring infiltrometers. This test method is difficult to use and the results may be unreliable in very coarse or heavy clay soils, or in frozen or highly fractured ~~soils~~. This test method may be conducted at the surface or at given depths in pits, and on bare soil or with vegetation in place, depending upon the conditions for which infiltration rates are desired.

2. Summary of Method

2.1 Infiltration rates can be measured in the

field using double-ring infiltrometers. Two open cylinders, one inside the other, are driven into the ground and partially filled with water which is then maintained at a constant level. The volume of water added to maintain the water level constant is the measure of the volume of water that infiltrates the soil. The volume infiltrated during timed intervals is converted to an infiltra-

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.04 on the Hydrologic Properties of Soil and Rocks.

Current edition approved Feb. 28, 1975. Published April 1975.

² Johnson, A. I., *A Field Method for Measurement of Infiltration*, U. S. Geological Survey Water-Supply Paper 1544-F, 1963, pp. 4-9.

tion velocity, usually expressed in inches per hour (or centimetres per hour). The maximum infiltration velocity is equivalent to the infiltration rate.

3. Apparatus

3.1 Infiltrometer Rings—Cylinders approximately 20 in. (50 cm) high and with different diameters of approximately 12 and 24 in. (30 and 60 cm). Cylinders can be made of $\frac{1}{8}$ -in. (3-mm), hard-alloy, aluminum sheet or other material sufficiently strong to withstand hard driving, with the bottom edge beveled from the outside to the inside edge (see Fig. 1). The beveled edges should be kept sharp. Larger rings can be calibrated in accordance with Table 1 and used, if economically feasible.

3.2 Driving Caps—Disks, of $\frac{1}{2}$ -in. (13-mm) aluminum alloy with centering pins around the edge. The diameters of the disks should be slightly larger than those of the infiltrometer rings.

3.3 Driving Equipment—A 12-lb (5.5-kg) maul or sledge and a 2 or 3-ft (60 or 90-cm) length of wood approximately 2 by 4 in. (5 by 10 cm) or 4 by 4 in. (10 by 10 cm).

3.4 Depth Gage—A hook gage, steel tape or rule, or length of heavy wire pointed on one end, for use in measuring and controlling the depth of water (head) in the infiltrometer ring.

3.5 Splash Guard—Several pieces of rubber sheet or burlap 6 in. (15 cm) square.

3.6 Rule or Tape—A 6-ft (2-m) steel tape or 1-ft (30-cm) steel rule.

3.7 Metal Tamp—Pipe, 14 in. (35 cm) long, with 6-in. (15-cm) length of 1 in. (25 mm) wide, $\frac{1}{4}$ in. (6 mm) thick steel strap welded to the end.

3.8 Shovels—One long-handled shovel and one trenching spade.

3.9 Hand Auger—Orchard-type auger with 3 in. (75 mm) in diameter, 9-in. (225-mm) long barrel and a rubber-headed tire hammer for knocking sample out of the auger.

3.10 Water Containers—One 50-gal (190-L) barrel for the main water supply; one 1000-mL graduated cylinder or a graduated Mariotté tube for measurement of water during the test; a 12-qt (12.7-L) pail for initial filling of the infiltrometer; and a length of rubber hose to siphon water from the barrel (see Fig. 2).

3.11 Water Supply—Preferably, water of the same quality and temperature as that involved

in the problem being examined.

3.12 Stop Watch.

3.13 Level—A carpenter's level or bull's-eye (round) level.

3.14 Recording Materials—Record books and graph paper, 20 by 20 lines/in. (8 by 8 lines/cm), or special forms with graph section (see Fig. 3).

4. Test Site

4.1 The test requires an area of approximately 10 by 10 ft (3 by 3 m), accessible by a truck.

4.2 The test site should be as nearly level as possible, or a level surface should be prepared.

4.3 The test may be set up in a pit if infiltration rates are desired at depth rather than at the surface.

4.4 Avoid sites where interference with test equipment is possible, such as sites near children or in pastures with livestock.

5. Procedure

5.1 Driving Infiltration Rings with a Sledge:

NOTE 1—Driving rings with a jack is the preferred method (see 5.2)

5.1.1 Place driving cap on the outer ring and center it thereon. Place the wood block (see 3.3) on the driving cap.

5.1.2 Drive the outer ring 6 in. (15 cm) into the soil with blows of a heavy sledge on the wood block. Use blows of medium force to prevent fracturing of the soil surface. Move the wood block around the edge of the driving cap every one or two blows so that the ring will penetrate the soil uniformly.

5.1.3 Center the smaller ring inside the larger ring and drive to a depth of 2 in. (5 cm), using same technique as in 5.1.2.

5.1.4 Check rings with the level, correcting the attitude of rings to be vertical, as needed.

5.2 Driving Infiltration Rings with Jacks:

5.2.1 Use a heavy jack and a truck to drive the rings as an alternative to the sledge method (see 5.1).

5.2.2 Center the wood block across the driving cap of the ring. Center a jack on the wood block. Place the top of the jack and the assembled items vertically under the previously positioned end of a truck body and apply force to the ring by means of the jack and truck reaction.

5.2.3 In heavy-textured soils, add additional

weight to the truck if needed to develop sufficient force to drive the ring.

5.2.4 Check rings with the level, correcting attitude of rings to be vertical, as needed.

5.3 *Tamping Disturbed Soil:*

5.3.1 If the soil is visibly disturbed more than $\frac{1}{8}$ in. (3 mm) from the wall of the ring, reset the ring with less disturbance of the sample.

5.3.2 If the soil is visibly disturbed less than $\frac{1}{8}$ in. (3 mm), tamp the disturbed soil adjacent to the inside wall of the ring with a metal tamp until the soil is as firm as it was prior to the disturbance.

5.4 *Maintaining Water Level:*

5.4.1 Install a depth gage or a Mariotté tube for each infiltrometer ring to assist the investigator visually in maintaining a constant head. For a depth gage, use a steel tape or rule, if the soils have high permeability. Use a hook gage, simple-point gage, or Mariotté tube if the soils have low permeability.

5.4.2 Install the gages to be used near the center of the center ring and also in the annular space midway between the two rings.

5.4.3 Cover the soil surface within the center ring and between the two rings with splash guards (6-in. (15-cm) square pieces of burlap or rubber sheet) to prevent erosion of the soil when the initial water supply is poured into the rings.

5.4.4 Use a pail to fill both rings with water to the same desired depth in each ring. Do not record this initial volume of water. Remove the splash guards.

5.4.5 Choose a head of at least 1 in. (2.5 cm) and not greater than 6 in. (15 cm) and maintain the water level at the selected head as near as possible throughout the test. The head is selected on the basis of the permeability of the soil, the higher heads being required for lower permeability soils.

5.5 *Measurements:*

5.5.1 Record all volumes of water that are added to maintain a constant head during a timing interval.

5.5.2 For average soils, record the volume of water used at intervals of 15 min for the first hour, 30 min for the second hour, and 60 min during the remainder of a period of at least 6 h, or until a maximum rate is obtained.

5.5.3 For high-permeability materials, take early readings more frequently. The exact schedule of readings can be determined only through experience.

5.5.4 For low-permeability materials, use a longer test interval, possibly 24 h, or more. Again, the exact schedule is determined through experience.

5.5.5 Place the driving cap or some other covering over the rings during the intervals between water measurements to minimize evaporation.

5.5.6 Upon completion of the test, remove the rings from the soil assisted by light hammering on the sides with a rubber hammer.

6. Calculations

6.1 Convert the volume of water used during each measured time interval into the depth of water per unit of time in inches (or centimetres) per hour. Table 1 can be used to convert volume measurements into equivalent depths of water by multiplying the volume of water used during the time interval by the area factor shown in the table. The infiltration velocity is obtained by dividing the depth of water by the time interval, in hours.

6.2 Make these calculations for the inner ring, the annular space, and both rings combined.

7. Report

7.1 Record the infiltration velocities in a record book or on a report form (see Fig. 3). Record the depth to the water table, if known, and a description of the soils found between the rings and the water table, or at least to a 20-ft (6-m) depth. Plot the data on the cross-sectioned part of the report form (see Fig. 3).

7.1.1 Record the temperature and the pH of the water used in the test. If available, a full analysis of the water should be recorded also.

7.2 The rate for the inner ring should be the value used if the rates for both rings and annular space differ. The difference in rates is due to divergent flow.

NOTE 2—Although not considered a required part of the test, the determination of the moisture pattern in the moistened soil beneath the infiltration rings commonly provides information useful in interpreting the movement of water through any particular soil profile. For example, water movement horizontally may be caused by lower-permeability layers and will result in a lateral spreading of the wetted zone. Thus, the exploration of the soils below an infiltration test in an unfamiliar area can determine the subsurface conditions that may affect the test and later applications of the data.

If the investigator chooses to make such a study, dig a trench so that one wall of the trench passes along the center line of the former position of the rings. Orient

the trench so that the other wall is illuminated by the sun, if the day is sunny. If feasible, dig the trench large enough to include all of the newly moistened area. Collect samples from the shaded wall of the trench for determination of moisture content. If preferred, an auger, such as the orchard barrel type, may be used to determine the approximate outline of the moistened

area below the rings and to collect samples for moisture content.

Plot the visibly-moistened area on graph paper or on the cross-section part of the report form (see Fig. 3). If samples were collected and moisture contents were determined, the contour of moisture content also can be plotted on the graph.

TABLE 1 Data for Double-Ring Infiltrimeters

Diameter of Ring(s), in. (cm)	Area of Annular Space, in. ² (cm ²)	Area of Ring, in. ² (cm ²)	Volume of Water Providing a 1-in. (2.5-cm) Depth, mL	Multiplication Factors to Convert Volume of Wa- ter Used in mL to Depth of Water in in. (cm)
12 and 24 (30 and 60)	339.3 (2189.2)	...	5561	1.80×10^{-4} (4.57×10^{-4})
12 (30)	...	113.1 (729.7)	1854	5.39×10^{-4} (13.70×10^{-4})
24 (60)	...	452.4 (2918.9)	7415	1.35×10^{-4} (3.43×10^{-4})

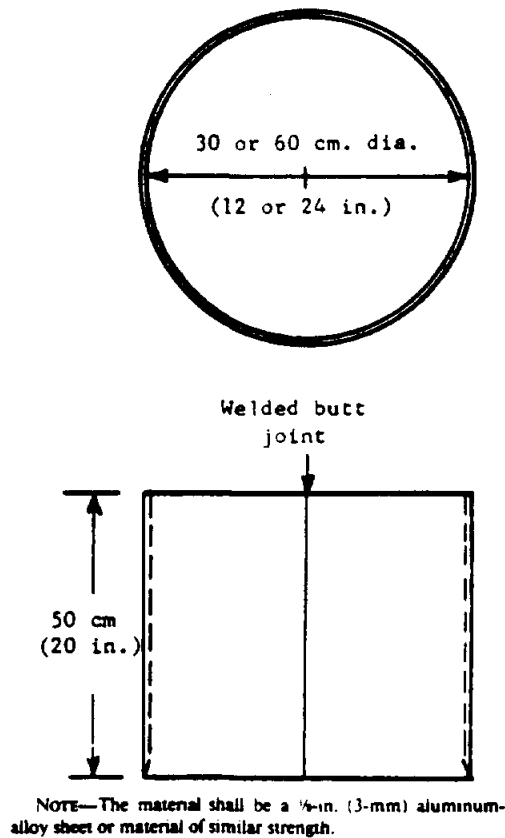
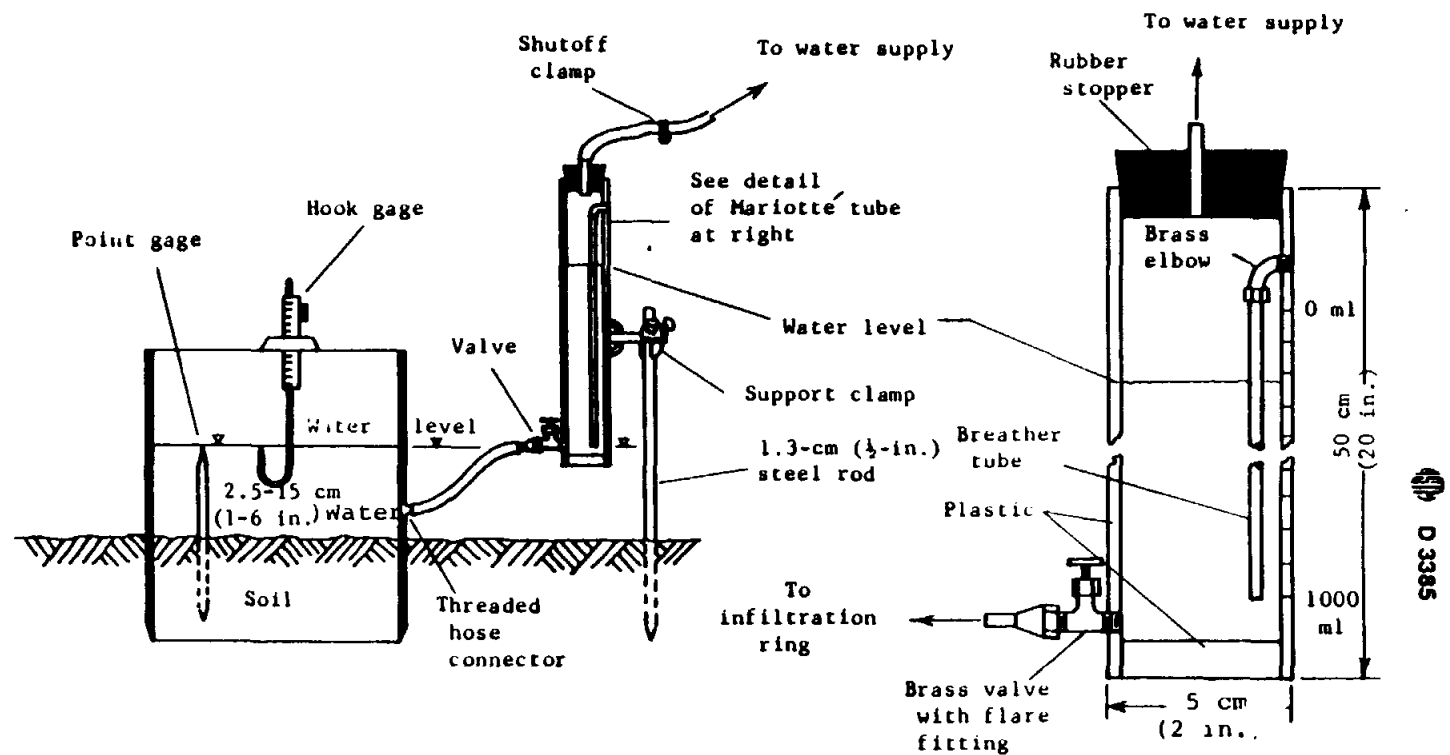


FIG. 1 Infiltrimeter Construction



NOTE—Center ring has been eliminated for simplification of the illustration.

FIG. 2 Ring Installation and Mariotte Tube Details

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.

Soil profile description

Soil, sandy, thin grass stand

Sand, v.f. to f, dry, loose

Basalt, dense surface

Site Sim. A

Date for report only

Date 10-14-55

Technician _____

Method 30 x 60 cm Double-ring Infiltrometer

Elapsed time, min	Quantity of water, ml	Infiltration rate, cm/hr
15	240	1.3
30	420	2.3
45	550	3.0
60	640	3.5
90	1560	4.3
120	1750	4.8
180	4000	5.5
240	3870	5.3
300	3500	4.8
360	3280	4.5

Soil profile description
Data for report only
Method (30 x 60 cm)

CROSS-SECTION OF MOIST AREA AND GRAPH OF INFILTRATION RATE

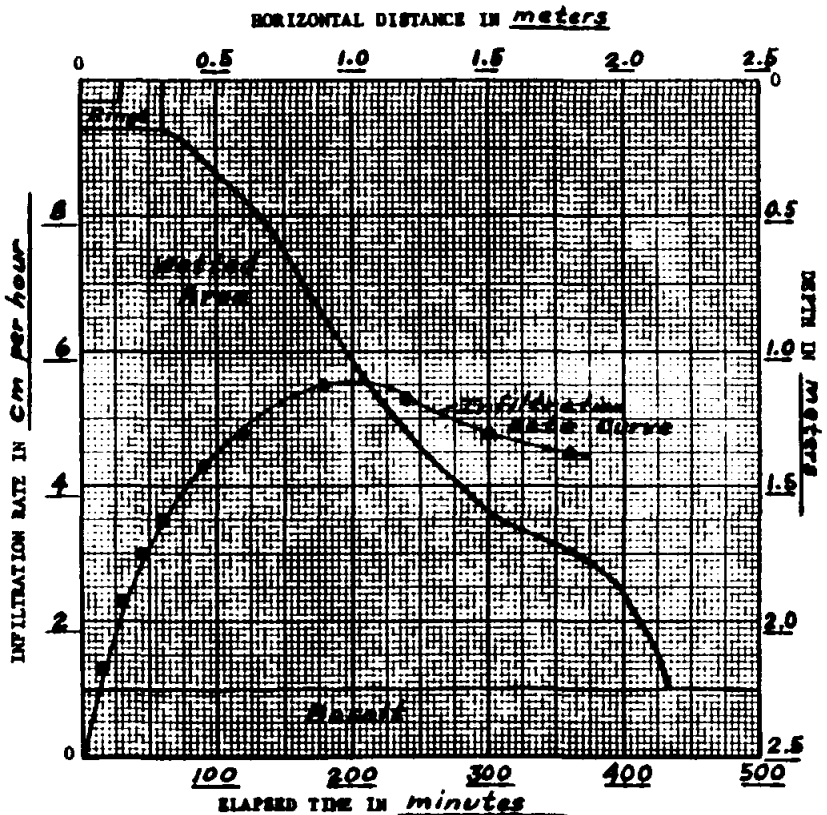


FIG. 3 Report Form for Infiltration Test with Sample Data

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

REFERENCE 2

ASTM METHOD D1586-84

STANDARD METHOD FOR PENETRATION TEST AND
SPLIT BARREL SAMPLING OF SOILS



Standard Method for PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS¹

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This method has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

1. Scope

1.1 This method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Applicable Documents

2.1 ASTM Standards:

- D 2487 Test Method for Classification of Soils for Engineering Purposes²
- D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)²
- D 4220 Practices for Preserving and Transporting Soil Samples²

3. Descriptions of Terms Specific to This Standard

3.1 *anvil*—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.2 *cathead*—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the ham-

mer by successively tightening and loosening the rope turns around the drum.

3.3 *drill rods*—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.4 *drive-weight assembly*—a device consisting of the hammer, hammer fall guide, the anvil, and any hammer drop system.

3.5 *hammer*—that portion of the drive-weight assembly consisting of the 140 ± 2 lb (63.5 ± 1 kg) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.6 *hammer drop system*—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.7 *hammer fall guide*—that part of the drive-weight assembly used to guide the fall of the hammer.

3.8 *N-value*—the blowcount representation of the penetration resistance of the soil. The *N*-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.9 ΔN —the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.10 *number of rope turns*—the total contact angle between the rope and the cathead at the

¹ This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D 1586 - 58 T. Last previous edition D 1586 - 67 (1974).

² Annual Book of ASTM Standards, Vol 04.08.

beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.11 *sampling rods*—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.12 *SPT*—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or *N*-value, and the engineering behavior of earthworks and foundations are available.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be suitable for advancing a borehole in some subsurface conditions.

5.1.1 *Drag, Chopping, and Fishtail Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.

5.1.2 *Roller-Cone Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 *Hollow-Stem Continuous Flight Augers*, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 *Solid, Continuous Flight, Bucket and Hand Augers*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not

cave onto the sampler or sampling rods during sampling.

5.2 *Sampling Rods*—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1½ in. (41.2 mm) and an inside diameter of 1¼ in. (28.5 mm)).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the *N*-values to depths of at least 100 ft (30 m).

5.3 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1½ in. (38 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

NOTE 2—Both theory and available test data suggest that *N*-values may increase between 10 to 30 % when liners are used.

5.4 Drive-Weight Assembly:

5.4.1 *Hammer and Anvil*—The hammer shall weigh 140 ± 2 lb (63.5 ± 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 *Hammer Drop System*—Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of the sampler while re-engaging and lifting the hammer.

5.5 *Accessory Equipment*—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 m) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do

not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance", or the "N-value". If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb

(63.5-kg) hammer shall be accomplished using either of the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m \pm 25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2¼ rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¼ or 2¼ rope turns, depending upon whether or not the rope comes off the top (1¼ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¼ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or the length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

8. Report

8.1 Drilling information shall be recorded in the field and shall include the following:

- 8.1.1 Name and location of job,
- 8.1.2 Names of crew,
- 8.1.3 Type and make of drilling machine,
- 8.1.4 Weather conditions,
- 8.1.5 Date and time of start and finish of boring,
- 8.1.6 Boring number and location (station and coordinates, if available and applicable),
- 8.1.7 Surface elevation, if available,
- 8.1.8 Method of advancing and cleaning the boring,
- 8.1.9 Method of keeping boring open,
- 8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,
- 8.1.11 Location of strata changes,
- 8.1.12 Size of casing, depth of cased portion of boring,
- 8.1.13 Equipment and method of driving sampler,
- 8.1.14 Type sampler and length and inside diameter of barrel (note use of liners),
- 8.1.15 Size, type, and section length of the sampling rods, and
- 8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in the field and shall include the following:

- 8.2.1 Sample depth and, if utilized, the sample number,
- 8.2.2 Description of soil,
- 8.2.3 Strata changes within sample,
- 8.2.4 Sampler penetration and recovery lengths, and
- 8.2.5 Number of blows per 6-in. (0.15-m) or partial increment.

9. Precision and Bias

9.1 Variations in *N*-values of 100 % or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, *N*-values in the same soil can be reproduced with a coefficient of variation of about 10 %.

9.2 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in *N*-values

obtained between operator-drill rig systems.

9.3 The variability in N -values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy

delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N -value adjustment is currently under development.

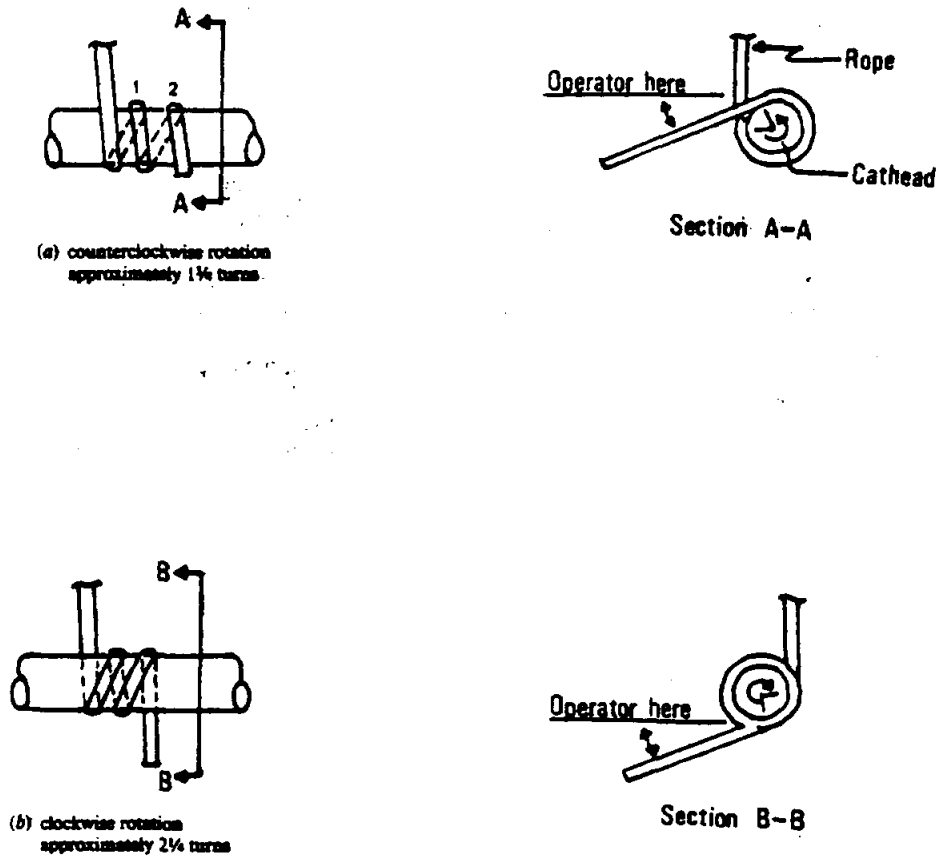
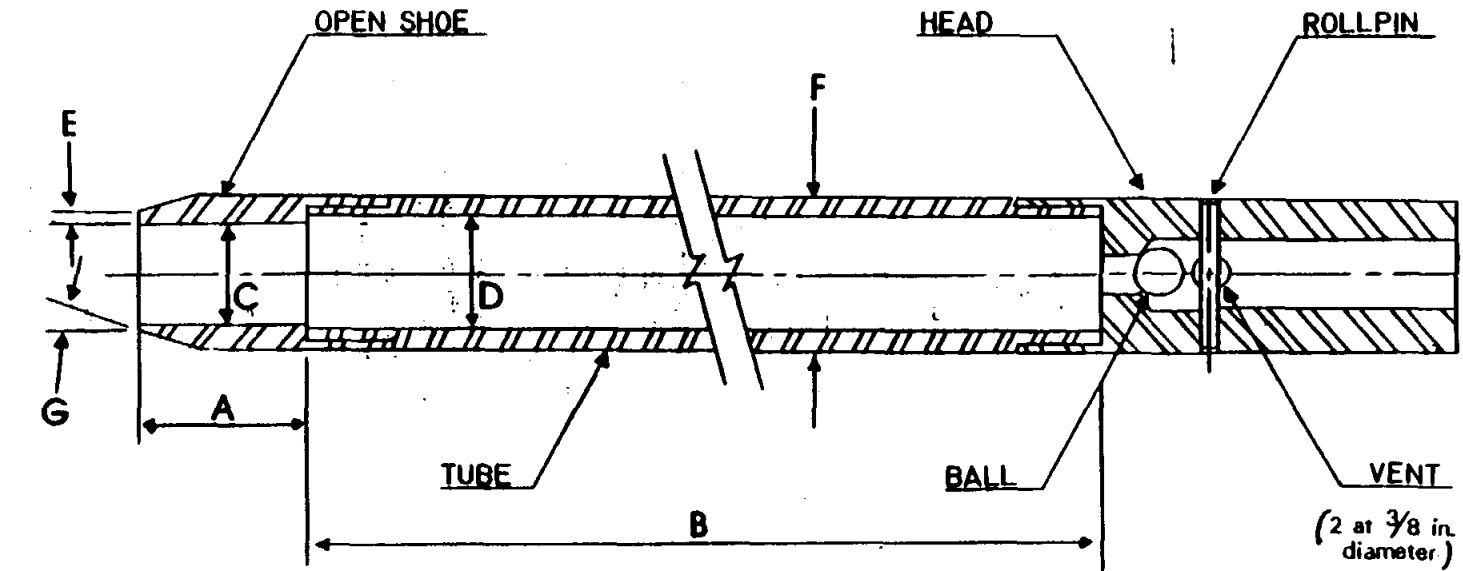


FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead



- A = 1.0 to 2.0 in. (25 to 50 mm)
 B = 18.0 to 30.0 in. (0.457 to 0.762 m)
 C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
 D = $1.50 \pm 0.05 - 0.00$ in. ($38.1 \pm 1.3 - 0.0$ mm)
 E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
 F = $2.00 \pm 0.05 - 0.00$ in. ($50.8 \pm 1.3 - 0.0$ mm)
 G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.

REFERENCE 3

METHOD FOR FIELD DESCRIPTION
OF
SOIL SAMPLES

REFERENCE 3

METHOD FOR FIELD DESCRIPTION OF SOIL SAMPLES

The interval from which each sample is collected shall be recorded in the log, along with the blow counts required for each six inches of split-spoon advance, hammer weight, and length of hammer fall. Also included on the log will be the sampler type and size (diameter and length), and an estimation of the percentage of sample recovery.

After opening the split-spoon, the principal component of the sample shall be determined and described first, followed by other components in decreasing order of importance. For each component, a general particle size will be given (e.g., sand), followed by any appropriate modifier (e.g., fine), a description of the color, and the degree of angularity/roundness. After all the constituents have been described, an indication of the overall sample properties shall be given, including, relative density, sorting, water content, odor, and any unusual coloration.

Using the resulting soil description, the sample shall be categorized according to the Unified Soil Classification System and assigned the appropriate group symbol.

REFERENCE 4

**CALIBRATION AND MAINTENANCE PROCEDURES
FOR FIELD EQUIPMENT**

- 4-A Calibration of MSA Samplair Pump**
- 4-B Calibration, Maintenance and Operation
of Model OVA-128 Portable Organic
Vapor Analyzer**
- 4-C Calibration of Mini-pH Meter**
- 4-D Calibration of YSI Model 33s-c-t
Conductivity Meter**

REFERENCE 4-A

CALIBRATION OF MSA SAMPLAIR PUMP

CALIBRATION OF SAMPLAIR PUMP

A field check of the flow rate will be performed on each pump on a daily basis. Maintenance and flow rate checks will be performed following the procedures listed below.

MAINTENANCE

Under conditions of normal usage the pump should require little maintenance. Always keep pump clean and dry and stored in carrying case when not in use.

Filter Disc - Periodically remove the filter disc for cleaning or replacement. To remove disc, roll flange portion of "tube holder" down and away from disc. Grip edge of disc with blunt tweezers and pull it out of tube holder. Gently tap or blow on surface to remove any foreign matter. Replace filter disc with previously exposed surface again facing upward.

Piston - Approximately every six months relubricate the pump piston with oil provided in kit. Pull handle all the way back. Wait approximately 30 seconds for evacuated pump to fill.

Manufactured by



MINE SAFETY APPLIANCES COMPANY
PITTSBURGH, PENNSYLVANIA, U.S.A., 15208

Disassembly - Unscrew cap and pull piston from cylinder. Apply lubricant to piston sparingly (2 or 3 drops). Start piston into cylinder taking care that no dirt or grit enters cylinder. Screw cap on hand tight and push handle all the way in to exhaust the pump.

Tube Holder - Replace when it shows signs of wear or loss of elasticity. Remove filter disc from discarded tube holder and replace in new tube holder or insert new filter disc. Screw the retaining nut down finger tight.

Pump Performance Tests - After an extended period of idleness and periodically during use, the pump should be checked for proper performance as indicated below.

Leakage Test - Insert detector tube, with tips unbroken, into tube holder. Pull handle back and lock in 100 cc position. Wait 2 minutes. Rotate the handle to release locking mechanism and guide slowly back. Do not allow handle to spring back. Once released the piston should return to the 0 cc position, indicating that the pump is satisfactory for use. If handle remains out more than 1/4" (approximately 5 cc) from 0 cc position, a pump leak is indicated, and the following steps should be taken:

1. Remove and examine tube holder for signs of wear or foreign particles on its sealing surfaces. If necessary replace tube holder, making sure that the retaining nut is screwed down snugly. Also examine seal for damage and replace if necessary.
2. Tighten the pump head assembly firmly, making sure O-ring is pressed uniformly.
3. Retest for leakage. If leakage persists (1) Relubricate the piston in manner

previously described and (2) check valve to make sure that there are no foreign particles between valve and seat and that the valve makes close contact with sealing area of piston. Retest for leakage. Also examine seal for damage and replace if necessary.

Flow Rate Tests - A simple field test to insure that the pump orifice or filter is not blocked may be made as follows:

Pull handle back and lock piston in 100 cc position. Wait 15 seconds and immediately rotate the handle to release locking mechanism and let handle fly back to position. The timing of the 15 seconds should start simultaneously to starting to pull the pump handle outward.

The piston should be drawn back part way toward its initial position. It should come to rest at the 50 cc position with the groove on the shaft within 1/2 inch of the cap. If it does not come to rest at this position inspect and if necessary clean or replace filter disc in the manner previously described.

A more precise method of checking flow rates can be made, using a 100 cc burette. The flow rate of the orifice may be checked by measuring the time (seconds) required for the pump to draw a volume of 80 cc when piston is fully withdrawn and locked in the 100 cc position. It should take 24-26 seconds to draw 80 cc of air.

These tests should be performed with no other resistance in the system except the filter and orifice. There should be no detector tube used in the flow rate tests.

If pump performance is inadequate and cannot be corrected by remedial measures outlined above, it should be returned to Mine Safety Appliances Company for repair.

REFERENCE 4-B

**CALIBRATION, MAINTENANCE AND OPERATION OF
MODEL OVA-128 PORTABLE ORGANIC VAPOR ANALYZER**

damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

The following are special instructions relative to batteries which have been allowed to completely discharge.

It has been established that the above battery recharging procedures may not be sufficient when the operator of the instrument has inadvertently left the INSTR Switch ON for a period of time without recharging and allowed the battery to completely discharge.

When this happens and the above procedures fail to recharge the battery, the following should be accomplished:

- 1) Remove the battery from the instrument case.
- 2) Connect to any variable DC power supply.
- 3) Apply 40 volts at 1/2 amp maximum.
- 4) Observe the meter on the power supply frequently and as soon as the battery begins to draw current, reduce the voltage on the power supply at a slow rate until the meter reads approximately 15 volts. NOTE: The time required to reach the 15 volt reading will depend on degree of discharge.
- 5) Repeat steps a), b), c), and d) above to continue charging.

2.7.2 DC CHARGER

- a) The optional DC charger is designed to both charge the battery and to provide power for operating the instrument from a 12 volt DC source, such as vehicle power.
- b) Connect the DC charger cord to the connector on the battery cover of the Side Pack Assembly. Plug the line cord into the vehicle cigarette lighter or other power source connection.
- c) In mobile applications, the DC charger is used to supply vehicle power to the instrument. Therefore, it may be left connected at all times.

2.8 CHARCOAL FILTERING

When it is desired to preferentially remove the heavier hydrocarbons, such as those associated with automobile exhaust, gasoline, etc., simply remove the pickup fixture from the end of the probe and install the optional charcoal filter assembly.

This same charcoal filter assembly can be installed directly into the Readout Assembly by using the adapter provided.

2.9 MOISTURE FILTERING

Filtering of moisture in the sample is not normally required. However, when moving in and out of buildings in cold weather, excessive condensation can form in the lines and detector chamber. In this case, the charcoal filter adapter can be filled with a desiccant such as "Drierite" which will filter out the moisture contained in the sample.

SECTION 3

SUMMARIZED OPERATING PROCEDURES

3.1 GENERAL

The procedures presented in this section are intended for use by personnel generally familiar with the operation of the instrument. Section 2 presents the comprehensive detailed operating procedures.

It is assumed that, prior to start up the positions of all switches and valves are in shut down configuration as described in paragraph 3.3.

3.2 START UP

- a) Move PUMP Switch to ON and check battery condition by moving the INSTR Switch to the BATT position.
- b) Move INSTR Switch to ON and allow five (5) minutes for warm-up.
- c) Set Alarm Level Adjust Knob on back of Readout Assembly to desired level.
- d) Set CALIBRATE Switch to X10 position, use CALIBRATE Knob and set meter to read 0.
- e) Move PUMP Switch to ON position then place instrument panel in vertical position and check SAMPLE FLOW RATE indication.
- f) Open the H2 TANK VALVE and the H2 SUPPLY VALVE.
- g) Depress Igniter Button until burner lights. Do not depress Igniter Button for more than six (6) seconds. (If burner does not ignite, let instrument run for several minutes and again attempt ignition.)
- h) Use CALIBRATE Knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE Knob and make differential readings from there.

3.3 SHUT DOWN

- a) Close the H2 SUPPLY VALVE and the H2 TANK VALVE.
- b) Move the INSTR Switch and PUMP Switch to OFF.
- c) Instrument is now in shut down configuration.

SECTION 4

CALIBRATION

4.1 GENERAL

The OVA is capable of responding to nearly all organic compounds. For precise analyses it will be necessary to calibrate the instrument with the specific compound of interest. This is especially true for materials containing elements other than carbon and hydrogen.

The instrument is factory calibrated to a methane in air standard. However, it can be easily and rapidly calibrated to a variety of organic compounds. A GAS SELECT control is incorporated on the instrument panel which is used to set the electronic gain to a particular organic compound.

Internal electronic adjustments are provided to calibrate and align the electronic circuits. There are four (4) such adjustments all located on the electronics board. One adjustment potentiometer, R-38, is used to set the power supply voltage and is a one-time factory adjustment. The remaining three adjustments, R-31, R-32 and R-33 are used for setting the electronic amplifier gain for each of the three (3) calibrate ranges. Access to the adjustments is accomplished by removing the instrument from its case. Figure 4-1 indicates the location of the adjustments.

4.2 ELECTRONIC ADJUSTMENTS

Primary calibration of this instrument is accomplished at the factory using methane in air sample gases.

1 GAIN ADJUSTMENT

- Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 300.
- Use the CALIBRATE ADJUST (zero) Knob and adjust the meter reading to zero.
- Introduce a methane sample of a known concentration (near 100 ppm) and adjust trimpot R-32 on circuit board (see Figure 4-1 for location) so that meter reads equivalent to the known sample.
- This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 300.
- Turn off H2 SUPPLY VALVE to put out flame.

4.2.2 BIAS ADJUSTMENT

- Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm.
- Place CALIBRATE Switch in X1 position and, using trimpot R-31 on circuit board, adjust meter reading to 4 ppm. (See Figure 4-1)
- Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.
- Move CALIBRATE Switch to X100 position and use trimpot R-33 on circuit board to adjust meter reading to 40 ppm.
- Move CALIBRATE Switch to X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero.
- Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

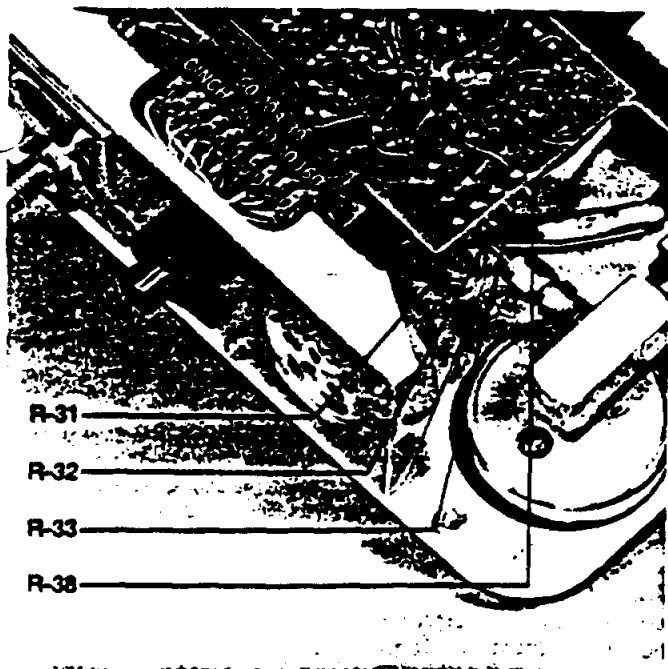


FIGURE 4-1. LOCATION OF ELECTRONIC ADJUSTMENTS

(Model OVA-118 shown; location typical to OVA-128)

4.3 CALIBRATION TO OTHER ORGANIC VAPORS

4.3.1 SETTING GAS SELECT CONTROL (Span)

Primary calibration of the instrument is accomplished using a known mixture of a specific organic vapor compound. After the instrument is in operation and the "normal background" is "zeroed out", draw a sample of the calibration gas into the instrument. The GAS SELECT Knob on the panel is then used to shift the readout meter indication to correspond to the concentration of the calibration gas mixture.

The instrument is then calibrated for the vapor mixture being used. After this adjustment, the setting on the "digidial" is read and recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds and when desiring to read a particular compound the GAS SELECT control is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

4.3.2 USING EMPIRICAL DATA

Relative response data may be obtained, which can then be used to estimate concentrations of various vapors. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The relative response, in percent, for that test vapor would then be the concentration read/concentration of the calibrated sample X 100.

4.3.3 PREPARATION OF CALIBRATION STANDARDS

4.3.3.1 COMMERCIAL SAMPLES

Commercially available standard samples offer the most convenient and reliable calibration standards and are recommended for the most precise analyses. Always remember to obtain the cylinder with the desired sample and the "balance as air". Sample should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

4.3.3.2 PURE GASEOUS SAMPLES

Obtain a large collapsible sample bag, preferably polyethylene such as a 40 gallon trash can liner. Insert a tube into the bag opening and tie shut around the tube. The tubing should have a shut-off valve or plug and be suitable for connecting the OVA input tube. Determine the volume of the bag by appropriate means (i.e., wet-test meter, dimensions of the bag, etc.). Forty gallon polyethylene bags provide a volume of approximately 140-160 liters. For gas samples, flush a 10 cc hypodermic syringe with the compound to be tested and then inject a 10 cc sample through the wall of the air-filled bag. Immediately after withdrawing the needle, cover the hole with a piece of plastic tape. Allow a few minutes for the sample to completely diffuse throughout the bag. Agitation will ensure complete diffusion. Connect the outlet tube to the OVA and take a reading. To verify repeatability of sampling technique, disconnect the bag and inject a second sample of the gas into the bag without emptying. Since only 2 or 3 liters will have been removed, the overall volume change will be small and the instrument reading should now be twice that of the

original. The concentration in ppm (V/V) will be equal to the sample size in cc divided by the volume of the bag in liters times 1000. For example, a 10 cc gas sample when placed in a 160 liter bag will provide a sample of 63 ppm, $10 \times 1000 / 160$ equals 63 ppm.

4.3.3.3 GASEOUS AND LIQUID SAMPLES (Alternate Method)

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 ml graduated cylinder, obtainable from scientific supply houses, is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, you obtain the volume of the bottle in liters. Empty the water out and allow the bottle to dry. Place a one-foot piece of plastic tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 ml. If the volume were 20,000 ml, then a 2 ml sample of a gas placed in the bottle would be equivalent to 200 ml per 2 million ml or 100 ppm (V/V). Use of a gas tight syringe, readable in 0.01 ml, allows the preparation of mixtures in the 1 - 2 ppm range, which are sufficient for the quantitative estimation of concentrations. A rubber stopper is loosely fitted to the top of the bottle and the needle of the syringe placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Put the stopper in tight and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure good mixture of the vapors with the air.

For liquid samples, use of the following equation will allow the calculation of the number of microliters of organic liquid needed to be placed into the bottle to make 100 ppm (V/V) of vapor.

$$V1 \text{ equals } V2 \times Mw / 244D$$

V1 - Volume of liquid in microliters needed to make an air mixture of 100 ppm (V/V)

V2 - Volume of bottle in liters

Mw - Molecular weight of substance

D - Density of substance

This procedure has the advantage that you can see when all of the organic liquid has vaporized and the volume can be determined readily.

For liquid samples, an alternate procedure involves the use of a diffusion dilution device such as that described by Desty, Geach and Goldup in "Gas Chromatography", R.P.W. Scott, ed., Academic Press, New York, 1961.

4.4 THEORY

Theoretical background and empirical data related to the Century Organic Vapor Analyzer is presented in 4.4.1 and 4.4.2.

4.4.1 HYDROCARBONS

In general, a hydrogen flame ionization detector is more sensitive for hydrocarbons than any other class of organic compounds. The response of the OVA varies from compound to compound, but gives excellent repeatable results with all types of hydrocarbons; i.e., saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes and alkynes) and aromatic hydrocarbons.

The typical relative response of various hydrocarbons to methane is as follows:

Compound	Relative Response (percent)
Methane	100 (reference)
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Ethane	90

4.4.2 OTHER ORGANIC COMPOUNDS

Compounds containing oxygen, such as alcohols, ethers, aldehydes, carboxylic acid and esters give a somewhat lower response than that observed for hydrocarbons. This is particularly noticeable with those compounds having a high ratio of oxygen to carbon such as found in the lower members of each series which have only one, two or three carbons. With compounds containing higher numbers of carbons, the effect of the oxygen is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

Nitrogen-containing compounds (i.e., amines, amides and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response as compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, CHCl_3 gives a much higher response than does CCl_4 . As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simple hydrocarbons.

The typical relative response of various compounds to methane is as follows:

Methane	100 (calibration sample)
Ketones	
Acetone	60
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
Alcohols	
Methyl alcohol	15
Ethyl	25
Isopropyl	65

REFERENCE 4-C

CALIBRATION OF MINI-PH METER

CARE AND FEEDING OF THE "MINI" & "DIGITAL"

I. GENERAL RECOMMENDATIONS

THE FOLLOWING RECOMMENDATIONS ARE PROVIDED AS A SUPPLEMENT TO THE CONDENSED OPERATING INSTRUCTIONS MOUNTED IN THE CARRYING CASE.

- When transferring from one solution to another, thoroughly rinse electrode with water, shaking off any excess water. This simple procedure will prevent "carry-over" contamination between samples.
- After immersing electrode in sample or buffer, stir solution slightly to improve electrode response time.
- When storing electrode for extended period, put several drops of distilled water in plastic boot and place boot over end of electrode.
- Optimum performance is obtained when buffers and samples are at the same temperature.
- If calibrate or span adjustments are made per Steps 4, 5, and 6 of the Condensed Operating Instructions (Steps 5, 6 & 7 for analog meter), repeat these steps to check new settings.

II. TEMPERATURE (SPAN) COMPENSATION

The "TEMP" knob serves the dual function of both temperature compensation and span adjustment.

Since pH electrode output is temperature dependent, the "TEMP" control corrects for changes in electrode output with temperature. Thus as solution temperature changes, the "TEMP" knob must be adjusted accordingly.

The "TEMP" control also provides a means of adjusting the span of the meter to compensate for electrodes having less than the theoretical output voltage. The cali-

bration procedure listed in the Condensed Operating Instructions performs the span adjustment when the "TEMP" knob is set to give a reading of 4.0 in 4.01 pH buffer. Thus, when the calibration is complete, the "TEMP" knob may be set to a temperature other than the actual solution temperature.

In such cases, the observed "temperature setting differential" indicates the amount of span adjustment required for proper calibration. If it becomes necessary to adjust the "TEMP" knob because of changes in solution temperature, maintain the above "temperature differential" for the new temperature setting. Note: For optimum performance, all solutions should be at the same temperature.

III. USE WITH BUFFER SOLUTION OTHER THAN 6.86 AND 4.01 pH

Some applications may require the use of buffer solutions other than 6.86 and 4.01 pH. In these cases, the Condensed Operating Instructions must be amended as follows:

- Step No. 4 (No. 5 for analog meter) - Immerse electrode in the buffer solution having a pH value nearest to 7 pH. Turn "CALIBRATE" knob so meter reads correct pH value.
- Step No. 6 (No. 7 for analog meter) - Immerse electrode in second buffer solution and turn "TEMP" knob (span adjust) so meter reads correct pH value of buffer solution.

IV. MEASUREMENT OF DEIONIZED WATER

The measurement of deionized water or other poorly buffered solutions requires additional care to insure satisfactory readings. Solutions of this nature are prone to contamination by "carry-over" from the previous sample.

Thoroughly rinse electrode with water and blot dry between each successive sample or buffer.

Solutions having low specific conductivity (e.g. high purity water) may present the additional measurement problem of apparent drift or instability. Although the effects can be minimized by stirring the sample during measurement, there are some applications where a replaceable combination electrode with a flowing reference is preferred.

V. TROUBLESHOOTING COMMON pH PROBLEMS

Most apparent instrument malfunctions are not associated with the electronic circuitry and can be traced to one or more of the following: weak batteries, contaminated buffers, improper measurement technique or inoperative electrode. If the pH meter fails to operate properly, the following checks should be made prior to returning the unit for repair:

- Replace batteries.
- Check meter using fresh buffer solutions.
- Check measurement procedure per Condensed Operating Instructions.
- Whenever possible, substitute a known good electrode.

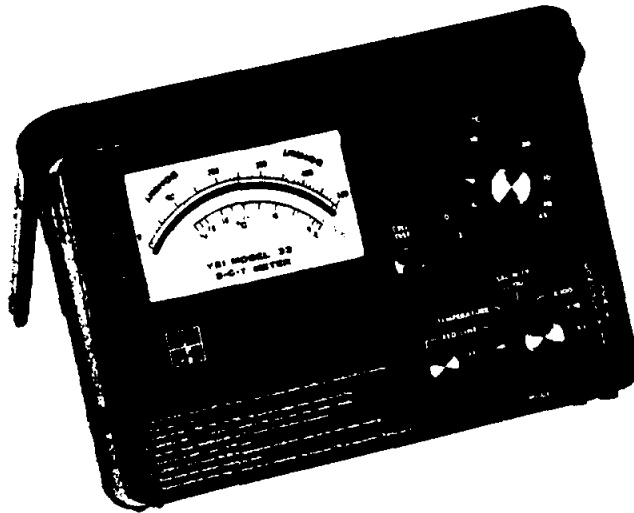
The following symptoms and proper corrective action will aid in locating the source of the problem.

- A. SLUGGISH RESPONSE - Clean electrode tip with mild detergent solution to remove any dirt or films on the membrane and rinse thoroughly. If condition persists, replace electrode.
- B. EXCESSIVE DRIFT - Clean electrode per "A" above. If condition persists, replace electrode.
- C. INSUFFICIENT SPAN - Clean electrode per "A" above.

REFERENCE 4-D

CALIBRATION OF YSI MODEL 33 S-C-T
CONDUCTIVITY METER

INSTRUCTIONS FOR YSI MODEL 33 AND 33M S-C-T METERS



Scientific Division
Yellow Springs Instrument Co., Inc.
Yellow Springs, Ohio 45387 • Phone 513-767-7241

PRICE INCLUDING HANDLING \$5.00

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GENERAL DESCRIPTION

The YSI Model 33 and 33M S-C-T Meters are portable, battery powered, transistorized instruments designed to accurately measure salinity, conductivity and temperature. They use a probe consisting of a rugged, plastic conductivity cell and a precision YSI thermistor temperature sensor combined in a single unit.

Conductivity with the Model 33 is expressed as micromhos/centimeter ($\mu\text{mhos/cm}$); with the 33M, it's millisiemens/meter (mS/m). These are measurements of the electrical conductance the sample would show if measured between opposite faces of a 1cm cube. (Conversion information: 1 $\mu\text{mho/cm}$ = 0.1 mS/m.) Salinity is the number of grams of salt/kilogram of sample (‰ = parts per thousand). This measurement assumes the sample contains a "standard" sea water salt mixture. The sample temperature is measured in degrees Celsius.

Salinity measurements are manually temperature compensated by direct dial. Conductivity measurements are not temperature compensated, however, a temperature function is provided on the instrument to aid with calculation of corrections. Also, when just temperature and conductivity are known it is possible to calculate salinity, and when only temperature and salinity are known it is possible to calculate conductivity.

SPECIFICATIONS

Model 33 Conductivity

Ranges	0-500, 0-5,000, 0-50,000 $\mu\text{mhos/cm}$ with YSI 3300 Series Probes (Note: The " μmho " designations on the meter are a shorthand form for " $\mu\text{mho/cm}$ ".)
Accuracy	$\pm 2.5\%$ max. error at 500, 5,000 and 50,000 plus probe $\pm 3.0\%$ max. error at 250, 2,500 and 25,000 plus probe See Error Section

2

Readability:	2.5 $\mu\text{mhos/cm}$ on 500 $\mu\text{mho/cm}$ range 25 $\mu\text{mhos/cm}$ on 5,000 $\mu\text{mho/cm}$ range 250 $\mu\text{mhos/cm}$ on 50,000 $\mu\text{mho/cm}$ range
--------------	---

Temperature Compensation: None

Model 33M Conductivity

Ranges	0-50, 0-500, 0-5,000 mS/m with YSI 3300 Series Probes
Accuracy:	$\pm 2.5\%$ max. error at 50, 500, and 5,000 plus probe. $\pm 3.0\%$ max. error at 25, 250, and 2,500 plus probe See Error Section.
Readability:	0.25 mS/m on 50 mS/m range 2.5 mS/m on 500 mS/m range 25.0 mS/m on 5,000 mS/m range.

Temperature Compensation: None

Salinity

Range	0-40 ‰ in temperature range of -2 to +45°C
Accuracy:	Above 4°C, $\pm 0.9 \text{‰}$ at 40 ‰ and $\pm 0.7 \text{‰}$ at 20 ‰ plus conductivity probe. Below 4°C, $\pm 1.1 \text{‰}$ at 40 ‰ and $\pm 0.9 \text{‰}$ at 20 ‰ plus conductivity probe. See Error Section.
Readability:	0.2 ‰ on 0-40 ‰ range
Temperature Compensation:	Manual by direct dial from -2 to +45°C

3

Temperature	
Range	2 to +50°C
Accuracy	±0.1°C at -2°C ±0.6°C at 45°C plus probe See Error Section
Readability	±0.15°C at 2°C to ±0.37°C at 45°C
Power Supply	
Two D-size alkaline batteries. Eveready E95 or equivalent, provide approximately 200 hrs. of operation.	
Probe	
YSI 3300 Series Conductivity/Temperature Probe	
Nominal Probe Constant K = 5/cm	
Accuracy	±2% of reading for conductivity and salinity Error of ±0.1°C at 0°C and ±0.3°C at 40°C
Instrument	
Ambient Range	Satisfactory operation -5 to +45°C A maximum error of ±0.1% of the reading per °C change in instrument temperature can occur. This error is negligible if the instrument is readjusted to redline for each reading.

OPERATION PROCEDURE

1. Setup

- Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale.
- Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter

needle lines up with the redline on the meter face. If this cannot be accomplished, replace the batteries.

- Plug the probe into the probe jack on the side of the instrument.
- Put the probe in the solution to be measured (See Probe Use.)

2. Temperature

Set the MODE control to TEMPERATURE. Read the temperature on the bottom scale of the meter in degrees Celsius. Allow time for the probe temperature to come to equilibrium with that of the water before reading.

3. Salinity

- Transfer the temperature reading from Step 2 to the °C scale on the instrument.
- Switch the MODE control to the SALINITY position and read salinity on the red 0-40 ‰ meter range.
- Depress the CELL TEST button. The meter reading should fall less than 2%. If greater, the probe is fouled and the measurement is in error. Clean the probe and re-measure.

4. Conductivity on Model 33 (Model 33M data are in parentheses.)

- Switch the MODE control to the X100 scale. If the reading is below 50 on the 0-500 range (5.0 on the 0-50 range), switch to the X10 scale. If the reading is still below 50 (5.0), switch to the X1 scale. Read the meter scale and multiply the reading appropriately. The answer is expressed in µmhos/cm (mS/m). Measurements are not temperature compensated.

Example: Meter Reading 247 (24.7)

Scale X10

Answer 2470 µmhos/cm
(247.0 mS/m)

(b) When measuring on the X100 and X10 scales, depress the CELL TEST button. The meter reading should fall less than 2%; if greater, the probe is fouled and the measurement is in error. Clean the probe and re-measure.

NOTE: The CELL TEST does not function on the X1 scale.

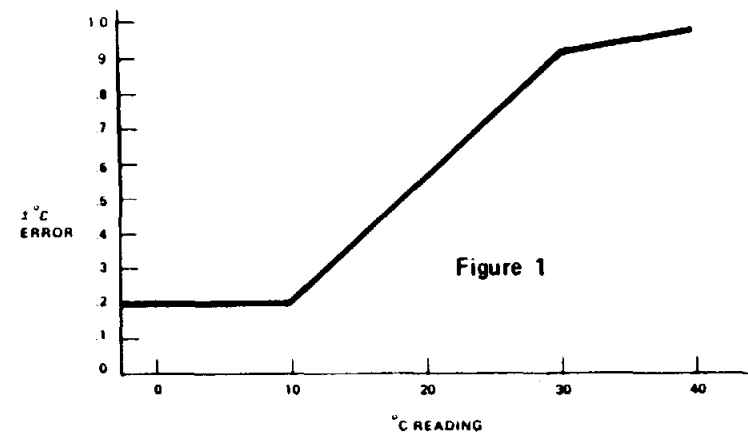
5. Error

The maximum error in a reading can be calculated by using the graphs in the following sections

(1) Temperature

The temperature scale is designed to give the minimum salinity error when the temperature readings are used to compensate salinity measurements.

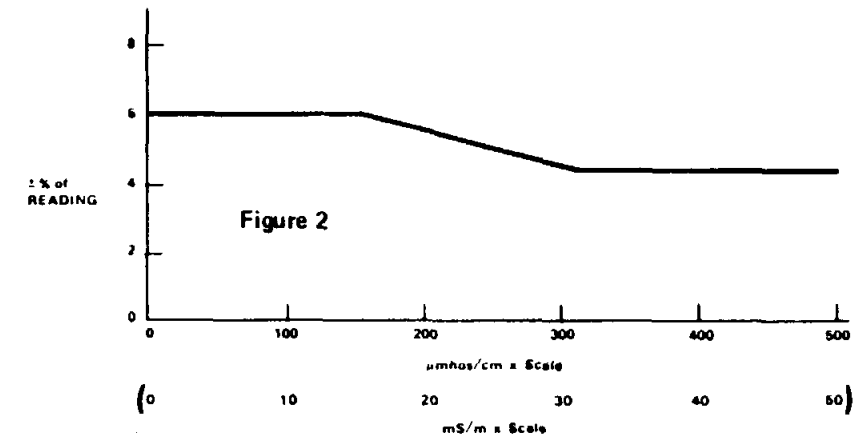
Figure 1 shows total error for probe and instrument versus °C meter reading.



Example: Meter Reading 15°C
 Total Error 0.4°C
 Accuracy 15°C ± 0.4°C for probe and instrument combined

(2) Conductivity on Model 33 (Model 33M data are in parentheses.)

Figure 2 shows the worst-case conductivity error as a function of the conductivity reading for the probe and instrument combined

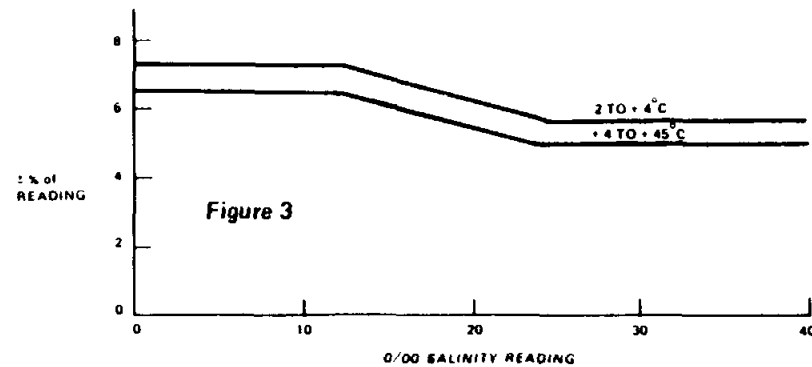


Example: Meter Reading 360 µmhos/cm (36 mS/m)
 Scale X10
 % Reading Error ± 4.5%
 Accuracy 3600 ± 162 µmhos/cm (360 ± 16.2 mS/m) for probe and instrument

(3) Salinity

The salinity readings are a function of temperature and conductivity, therefore the accuracy is a function of both.

The temperature scale and temperature control have been designed to minimize the temperature error contribution to the salinity error. The error shown in Figure 3 is the total of the temperature and conductivity probe, the temperature scale and the salinity scale error.



Example: Meter Reading: 10 0/00, @ 10°C
% of Reading Error: 6.5%
Accuracy: 10 ‰ ± 0.65 ‰ for all errors, combined worst case.



- 1 Resistance values in ohms. $K = 1,000$, resistors are $\frac{1}{2}W$ 10% unless otherwise specified
- 2 The values shown on the schematic may differ from those in the instrument, if so, either value can be used for replacement purposes
- 3 Battery is "D" size alkaline only. Eveready E 95 or equal

- 1 Resistance values in ohms. $K = 1,000$, resistors are $\frac{1}{2}W$ 10% unless otherwise specified
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- 3 Battery is "D" size alkaline only. Eveready E 95 or equal

CIRCUIT DESCRIPTION, MAINTENANCE AND CALIBRATION

1. Description

The circuit is composed of two parts: a multivibrator and switching transistors. The multivibrator produces a square waveform voltage. The square wave is applied to two switching transistors. They alternately apply two batteries of opposite polarity to the probe thus providing AC power which minimizes polarization effects. The meter is in series with one battery and measures the current from it. The current from the battery is proportional to the conductance of the cell. Salinity is measured in a special range conductivity circuit which includes a user-adjusted temperature compensator. In the temperature, redline and X1 positions the multivibrator operates at 100 Hz. In the salinity, X100 and X10 positions the multivibrator operates at 600 Hz and in these ranges pushing the CELL TEST button drops the frequency to 100 Hz allowing the operator to judge the degree of probe polarization.

2. Maintenance

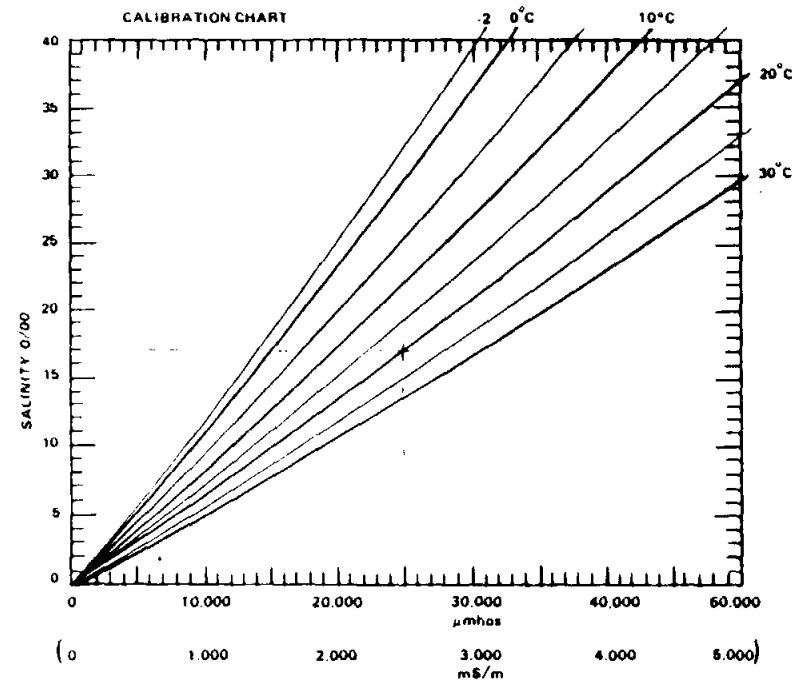
The only maintenance required is battery replacement. Two "D" size alkaline flashlight cells, such as Eveready E95 or equivalent, will provide 200 hrs. of operation. Accuracy will not be maintained if zinc-carbon "D" cells are used. Battery replacement is indicated when the redline adjustment cannot be accomplished.

Replace batteries every six months to reduce the danger of corrosion due to leaky batteries. To replace batteries, remove the six screws from the rear plate. The battery holders are color coded. The Positive (+ button) end must go on red.

3. Calibration of Model 33 (Model 33M data are in parentheses.)

It is possible for the temperature knob to become loose or slip from its normal position. In an emergency the dial can be re-positioned. It must be emphasized that this is an emergency procedure only, and that the instrument should be returned to the factory for proper recalibration at the earliest opportunity.

- (a) Read the temperature and conductivity of the solution. Determine the salinity of the solution by running a line vertically on the graph from this conductance value until it intersects the appropriate °C line (interpolate as required for temperature between the given °C lines). From this intersection extend a



line horizontally to the edge of the graph. This determines the salinity for this sample.

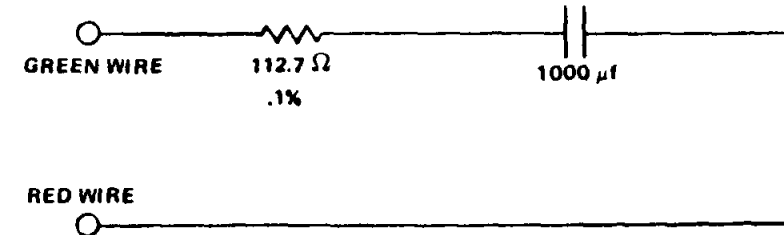
Example: 25,000 $\mu\text{mhos/cm}$ and 20°C gives a salinity of 17 (Example: 2,500 mS/m and 20°C gives a salinity of 17.)

- (b) Remove the °C knob, switch to SALINITY, and turn the control shaft until the meter needle indicates the salinity value determined in Step (a). In the example given, the value is 17.
- (c) Switch to TEMPERATURE. (Note: This temperature reading must be the same as Step (a); if not, begin again at Step (a).) Place the knob on the control shaft (without turning the control shaft) with the knob pointer at the same temperature as the meter reading and tighten both set screws securely.

At earliest opportunity recalibrate using the following procedure or return the instrument to factory for service.

- (a) Set the instrument for a salinity measurement as normal.
- (b) Substitute a 1000 μf capacitor and 112.7 ohm 0.1% tolerance resistor for the probe.

Connect the resistor and capacitor between the green wire and red wire on the jack connections inside the instrument.



(c) Turn the temperature dial until the meter reads redline. Now install the temperature knob with the arrow at 25°C. This is a temporary calibration only. Return the instrument to the factory for proper recalibration.

PROBE

1. Description of YSI 3300 Series Conductivity/Temperature Probe

The YSI 3300 Series Conductivity Probes are designed for field use embodying construction and design for rugged, accurate service. Each probe features a built-in cell constant of 5.0 (500 Ω/M) ±2%, a precision YSI thermistor temperature sensor of ±0.1°C accuracy at 0°C and ±0.3°C at 40°C and a low capacitance cable assembly terminating in a three terminal 0.25" dia. phone type connector.

The 3310 has a 10 ft. cable and the 3311 is a 50 ft. version. Other lengths are available on special order.

The probe has a rigid P.V.C. body, platinized pure nickel electrodes, and a durable cable providing resistance to a wide range of water-borne substances.

2. Maintenance

(a) Cleaning

When the cell test indicates low readings the probable cause is dirty electrodes. Hard water deposits, oils and organic matter are the most likely contaminants.

For convenient normal cleaning soak the electrodes for 5 minutes with a locally available bathroom tile cleaning preparation such as: Dow Chemical Bathroom Cleaner, Horizon Industries Rally Tile, Porcelain and Chrome Cleaner, Johnson Wax Envy, Instant Cleaner, or Lysol Brand Basin, Tub, Tile Cleaner.

For stronger cleaning a 5 minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol and 1 part HCl can be used.

Always rinse the probe after cleaning and before storage.

CAUTION: Do not touch the electrodes inside the probe.

Platinum black is soft and can be scraped off.

If cleaning does not restore the probe performance, re-platinizing is required.

(b) Re-Platinizing

Equipment Required —

- (1) YSI #3140 Platinizing Solution, 2 fl. oz. (3% platinum chloride dissolved in 0.025% lead acetate solution)
- (2) YSI Model 33 or 33M S-C-T Meter.
- (3) 50 ml glass breaker or equivalent bottle
- (4) Distilled water.

Procedure —

- (1) Clean the probe as in Section (a) — either method.
- (2) Place the cell in the beaker and add sufficient YSI #3140 solution to cover the electrodes. Do not cover the top of the probe.
- (3) Plug the probe into the Model 33 or 33M, switch to the X100 scale to platinize the electrode. Move the probe slightly to obtain the highest meter reading and continue platinizing for the approximate time shown below:

Meter Reading		Time (minutes)
μmhos/cm	mS/m	
30,000	3,000	5
25,000	2,500	6
20,000	2,000	8
15,000	1,500	11
10,000	1,000	16

- (4) After the elapsed time remove the probe and rinse in fresh water
- (5) Return the solution to its container. 2 oz. of solution should be sufficient for 50 treatments
- (c) Storage
It is best to store conductivity cells in deionized water. Cells stored in water require less frequent platinization. Any cell that has been stored dry should be soaked in deionized water for 24 hours before use.

3. Probe Use

- (a) Obstructions near the probe can disturb readings. At least two inches of clearance must be allowed from non-metallic underwater objects. Metallic objects such as piers or weights should be kept at least 6 inches from the probe.
- (b) Weights are attached to the cable of the YSI 3310 and 3311 Probes. The YSI 3327 Weights are supplied in pairs with a total weight of 4 ounces per pair. Should it become necessary to add more weight to overcome water currents, we suggest limiting the total weight to two pounds (8 pairs). For weights in excess of two pounds use an independent suspension cable. In either case, weights must be kept at least 6 inches away from the probe.
- (c) Gentle agitation by raising and lowering the probe several times during a measurement insures flow of specimen solution through the probe and improves the time response of the temperature sensor.

4. Cell Calibration & Standard Solutions

The YSI #3300 Series Cells are calibrated to absolute accuracy of $\pm 1.5\%$ based on a standard solution. Since the literature on conductivity does not indicate a consistently accepted standardization method, we have chosen the 0.01 normal KCl solution method as determined by Jones and Bradshaw in 1937 as our standard. Recent textbooks, as well as the ASTM standards, concur with this choice.

The solution is prepared by diluting 0.745 grams of pure dry KCl with distilled water until the solution is 1 kilogram. The table below shows the values of conductivity this solution would have if the distilled water were non-conductive. However, since even high purity distilled water is slightly conductive, the measured conductivity will be higher by an amount equal to the water's conductivity.

Temperature °C	Conductivity	
	$\mu\text{mhos/cm}$	mS/m
15	1141.5	114.2
16	1167.5	116.8
17	1193.6	119.4
18	1219.9	122.0
19	1246.4	124.6
20	1273.0	127.3
21	1299.7	130.0
22	1326.6	132.7
23	1353.6	135.4
24	1380.8	138.1
25	1408.1	140.8
26	1436.5	143.7
27	1463.2	146.3
28	1490.9	149.1
29	1518.7	151.9
30	1546.7	154.7

The operator may use the standard solution and the table to check accuracy of a cell's constant or to determine an unknown constant. The formula is shown below.

$$K = \frac{R(C_1 + C_2)}{10^6} \quad \text{or} \quad \frac{R(S_1 + S_2)}{10^5}$$

where K = Cell constant
R = Measured resistance in Ω

- C_1 = Conductivity in $\mu\text{mhos/cm}$
 C_2 = Conductivity in $\mu\text{mhos/cm}$ of the distilled water used to make solution
 S_1 = Conductivity in mS/m
 S_2 = Conductivity in mS/m of the distilled water used to make the solution

R. C_1 and C_2 , or S_1 and S_2 , must either be determined at the same temperature or corrected to the same temperature to make the equation valid.

Note: For further information on conductivity and the above standard information, refer to ASTM Standards Part 23 — Standard Methods of Test for Electrical Conductivity, or Water and Industrial Waste Water — ASTM Designation D1125-64

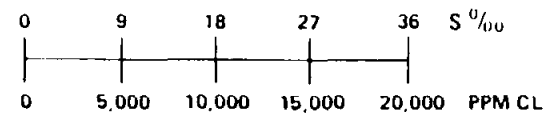
YSI MODEL 33 AND 33M USED WITH YSI 51A, 54 and 57 OXYGEN METERS

If the salinity measurement is to be used for salinity correction on the 51A, the reading should be converted to Chlorosity. The formula is

$$\text{PPM Chlorosity} = \frac{\text{Salinity } ^\circ\text{‰} + 0.03}{1.8} \times 10^3$$

For these instruments the 0.03 can be neglected so the equation simplifies to

$$\text{PPM Cl} = \frac{\text{SS } ^\circ\text{‰} \times 10^3}{1.8}$$



For salinity correction when using the Model 57 use the salinity reading direct from the Model 33 or 33M. No conversion is necessary.

Model 33 and 33M salinity readings taken in conjunction with Model 54 dissolved oxygen readings can be used to correct the Model 54 for salinity and to make post-measurement salinity corrections to dissolved oxygen data. Correction tables are available from the factory.

WARRANTY

All YSI products carry a one-year warranty on workmanship and parts, exclusive of batteries. Damage through accident, misuse, or tampering will be repaired at a nominal charge.

If you are experiencing difficulty with any YSI product, it may be returned to an authorized YSI dealer for repair, even if the warranty has expired. If you need factory assistance for any reason, contact:

Service Department
 Yellow Springs Instrument Co., Inc.
 P.O. Box 279
 Yellow Springs, Ohio U.S.A.
 Phone (513) 767-7241

REFERENCE 5

**FIELD PRETREATMENT PROCEDURES
FOR REMOVAL OF SULFIDES AND OXIDIZING
AGENTS IN AQUEOUS SAMPLES COLLECTED FOR
CYANIDE ANALYSIS**

I. SUMMARY

In order to meet EPA requirements for collection of aqueous samples for cyanide analysis the spot tests for sulfide and oxidizing agents described below should be performed in the field prior to preservation of the sample with sodium hydroxide. Sulfide and oxidizing agents (e.g., chlorine) are interferences in the measurement of cyanide in aqueous samples and must be removed the day of sample collection. Samples must be analyzed for cyanide within 14 days of collection.

Note: Perform the sulfide spot test first. If positive, it may be assumed that oxidizing agents are not present and therefore the oxidizing agent spot test need not be performed.

II. SULFIDE SPOT TEST AND REMOVAL

A. TEST SUMMARY

In general, a small aliquot of the sample will be tested for the presence of sulfide using two techniques: the lead acetate indicator paper spot test and the cadmium nitrate powder spot test. Both tests result in a color change in the presence of sulfide. The lead acetate paper darkens in the presence of sulfide while a yellow precipitate is formed upon addition of cadmium nitrate powder. Both visual tests will be used and if positive, sulfide will be removed before sample preservation. Sulfide is removed as a yellow precipitate by the addition of cadmium nitrate powder and separated from the sample by filtration.

B. APPARATUS

1. Eyedropper or Pastuer pipette
2. Plastic weighing boat or disposable beaker
(for performing spot test)
3. Lead acetate indicator paper
4. Spatula

5. Filtration apparatus

- a) A suitable apparatus of polyethylene or glass construction to rapidly filter the volume of sample needed should be used. All pieces must be thoroughly cleaned between uses to avoid contamination.
- b) Filter papers of Whatman #1 grade or equivalent

C. REAGENTS

1. Cadmium nitrate powder [$\text{Cd}(\text{NO}_3)_2$]
2. Sodium acetate buffer solution (pH 4.0)

Dissolve 146 g anhydrous $\text{NaC}_2\text{H}_3\text{O}_2$, or 243 g $\text{NaC}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$, in 400 ml distilled water. Add 480 g conc. acetic acid, and dilute to 1 L with distilled water.

D. PROCEDURE -- SPOT TEST

Collect the appropriate volume of sample (at least 1 Liter) in the plastic bottle (Note: do not preserve the sample with NaOH). Pour about 50 ml of the sample into the plastic weighing boat or disposable beaker. The spot tests will be performed on this aliquot.

1. Lead acetate indicator paper spot test
 - a) Moisten a strip of the lead acetate indicator paper with the sodium acetate buffer solution.
 - b) Using an eyedropper or Pastuer pipette, place a drop of sample to be tested on the moistened lead acetate indicator paper.
 - c) Observe any color change of the lead acetate indicator paper. Darkening of the paper indicates the presence of sulfide.
 - d) If a positive test should occur then the sulfide must be removed from the sample by precipitation with cadmium nitrate powder, followed by filtration to remove the cadmium sulfide precipitate (described below, Section E).

2. Cadmium nitrate powder addition spot test

- a) Add a small portion (spatula tip) of cadmium nitrate powder to the sample aliquot. The formation of a yellow precipitate indicates the presence of sulfide.
- b) If a positive test should occur then the sulfide must be removed from the sample by precipitation with cadmium nitrate powder, followed by filtration to remove the cadmium sulfide precipitate (described below, Section E).

E. PROCEDURE -- SULFIDE REMOVAL

1. If there are any particulates present in the sample (indicated by the presence of sediment on bottom or turbid sample), and especially if metal/cyanide complexes are suspected in the sample, then the sample must be filtered (using the same apparatus and paper as for the sulfide precipitation) before sulfide removal. Save the filtered particulates for reconstitution of the sample (step 4 below) once sulfide removal has been completed.
2. To precipitate sulfide from the sample add cadmium nitrate powder in small amounts (spatula tip) until a drop of treated sample no longer causes the lead acetate indicator paper to darken and a yellow ppt. no longer forms.
3. Filter the sample to remove the cadmium sulfide precipitate. Discard the yellow precipitate.
4. Reconstitute the sample by returning the particulates removed in step (1) with the filter paper to the sample.

F. QUALITY CONTROL

A clean distilled water sample should be treated as described above at a frequency of 1 per 10 samples. Label the sample as a cyanide spot test blank (e.g., CN spot test BLK) and note the group of corresponding samples if more than one CN spot test blk was run that day. Send samples to the laboratory for cyanide analysis. This procedure checks for contamination introduced during sample pretreatment.

III. OXIDIZING AGENT SPOT TEST AND REMOVAL

A. TEST SUMMARY

In general a small aliquot of the sample will be tested for the presence of oxidizing agents (e.g., chlorine) using potassium iodide-starch indicator paper. A bluish discoloration of the potassium iodide-starch paper indicates the presence of oxidizing agents. Oxidizing agents can be removed by the addition of ascorbic acid. :

B. APPARATUS

1. Eyedropper or Pastuer pipette
2. Spatula
3. Filtration apparatus
 - a) A suitable apparatus of polyethylene or glass construction to rapidly filter the volume of sample needed should be used. All pieces must be thoroughly cleaned between uses to avoid contamination.
 - b) Filter papers of Whatman #1 grade or equivalent

C. REAGENTS

1. Potassium iodide-starch indicator paper (KI-starch paper)
2. Ascorbic acid, crystal ($C_6H_8O_6$)
3. Sodium acetate buffer solution (pH 4.0)

Dissolve 146 g anhydrous $NaC_2H_3O_2$, or 243 g $NaC_2H_3O_2 \cdot 3H_2O$, in 400 ml distilled water. Add 480 g conc. acetic acid, and dilute to 1 L with distilled water.

D. PROCEDURE

1. The sample aliquot collected for the spot test procedure, Section II, D above, may be used for this test.
2. Potassium iodide-starch indicator paper spot test.
 - a) Moisten a strip of KI-starch paper with the sodium acetate buffer solution.
 - b) Using an eyedropper or Pastuer Pipette, place a drop of sample to be tested on the moistened KI-starch paper.
 - c) Observe any color change of the KI-starch paper. A bluish discoloration of the paper indicates the presence of oxidizing agents.
 - d) If a positive test should occur then the oxidizing agents must be removed by the addition of ascorbic acid.
 - e) If there are any particulates present in the sample, and especially if metal cyanide complexes are suspected in the sample, then the sample must be filtered before oxidizing agents are removed. Save the filtered particulates for reconstitution of the sample (step h) once oxidizing agents have been removed.
 - f) To remove oxidizing agents in the sample, add 0.6 g of ascorbic acid and retest with the KI-starch paper. Repeat addition if necessary.
 - g) When a drop of treated sample no longer discolors the KI-starch paper an additional 0.6 g of ascorbic acid should be added to the sample.
 - h) Reconstitute the sample by returning the particulates removed in step (e) with the filter paper to the sample.

E. QUALITY CONTROL

A clean distilled water sample should be treated as described above at a frequency of 1 per 10 samples. Label the sample as a cyanide spot test blank (e.g., CN spot test BLK) and note the group of corresponding samples if more than one CN spot test blk was run that day. Send samples to the laboratory for cyanide analysis. This procedure checks for contamination introduced during sample pretreatment.

REFERENCES

1. USEPA 40 CFR Part 136, Federal Register, Vol. 49, No. 209, October 26, 1984, and Vol. 50, No. 3, January 4, 1985.
2. Standard Methods for the Examination of Water and Waste Water, 16th Edition, 1985
3. Letter from N. Lewis (EPA) to J. Bou, 26 June 1986 with attachment from G. McKee, Inorganic Analyses Section, EPA-EMSL, Cincinnati, OH.

REFERENCE 6

OPERATIONS AND QUALITY ASSURANCE PROCEDURES
MANUAL FOR ORMET SITE

1.0 INTRODUCTION

This document presents the quality assurance/quality control procedures used by Energy & Environmental Management, Inc. (E²M), for high volume samplers (also PM₁₀ monitors).

2.0 PM₁₀ MONITOR SITING AND INSTALLATION

The Hi-Vols are located from 2 to 15 meters above ground level. The lower level limit is to avoid reentrainment from dusty surfaces. The upper limit represents a compromise between the desire to have measurements which are representative of population exposure and the other considerations listed below.

2.1 SPACING FROM OBSTRUCTIONS

2.1.1

Whenever a sampler is located on a roof, it is located at least two meters from walls, parapets, penthouses, etc. If a furnace or incineration flue is located on the roof, the distance between it and the sampler is dependent on: 1) the height of the flue; 2) type of waste or fuel burned; and, 3) the ash content of the emission. If the emission from the chimney is the result of natural gas combustion, no special precautions are necessary beyond the two meter separation distance. If fuel oil, coal or solid wastes is burned and the chimney is sufficiently short to allow a plume to impact on the sample intake, the site is not selected as a NAMS or SLAMS.

2.1.2

Trees provide surfaces for particulate deposition and restrict air flow. For this reason the samplers are usually located 20 meters or more from the nearest tree.

2.1.3

Every attempt has been made to locate samplers away from nearby obstacles such as buildings so that the distance between an obstacle and a sampler is at least twice the height that the obstacle protrudes above the sampler.

2.1.4

There must also be unrestricted air flow in an arc of at least 270 around the sampler. The predominant wind direction must be included in the 270 arc.

2.2 SPACING FROM ROADS

2.2.1

TSP concentration decreases with increasing height of the sampler and its distance from the road (1). Therefore, samplers are not located close to the street where there is a concentrated plume of particulate matter generated and emitted by vehicle traffic.

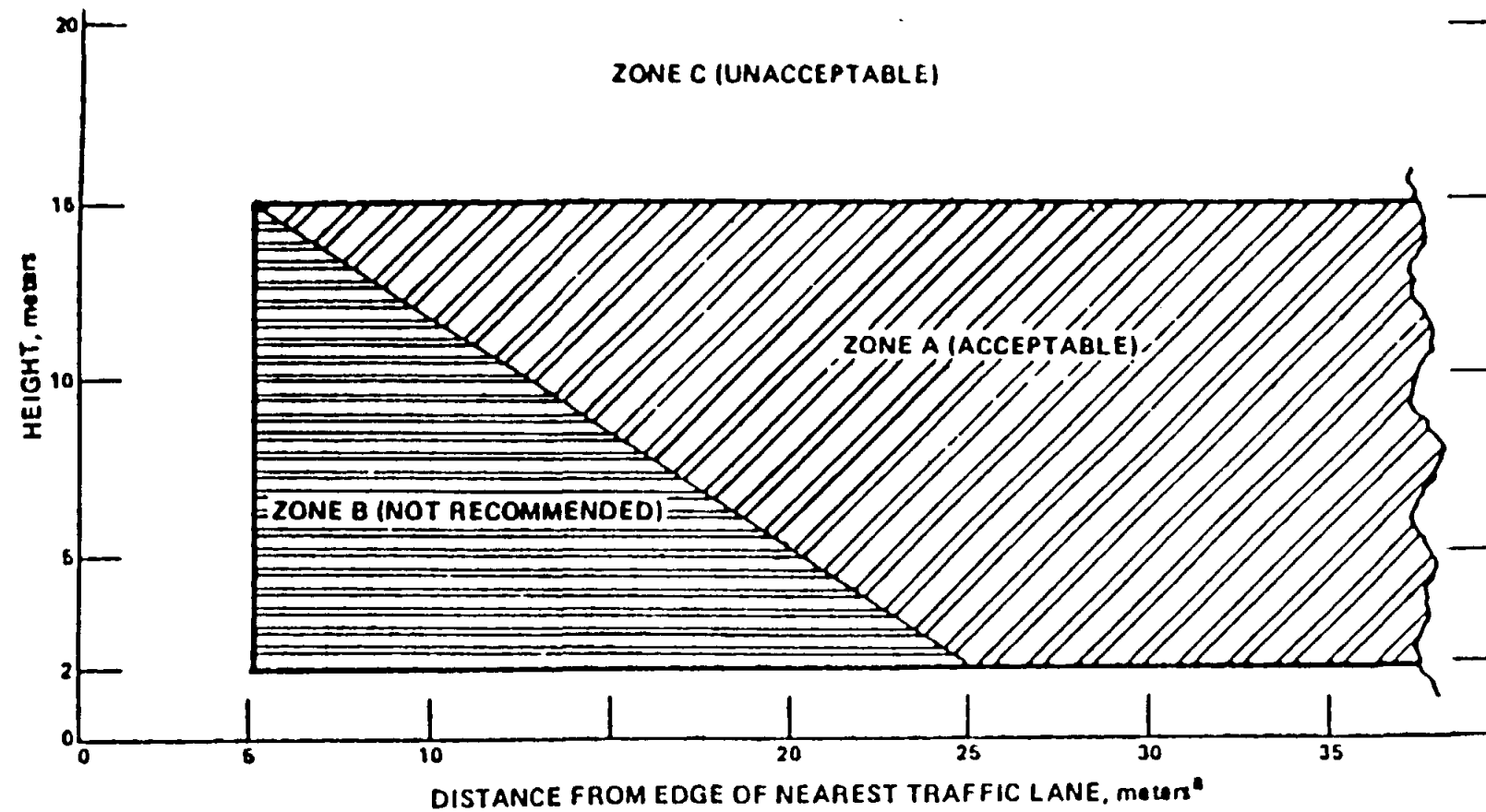
2.2.2

Analysis shows that a linear relationship between sampler height and distance from the road defines a zone where the plume (generated by traffic greater than 3,000 vehicle per day) is diminished. Figure 1 illustrates this. Zone A represents locations which are recommended for neighborhood, urban and regional scales and also for most middle scale locations. Zone B is avoided in order to minimize roadway influences. Any SLAM located in Zone B is classified as having a middle scale of representativeness.

2.2.3

Since roads with traffic less than 3,000 vehicles per day do not generate a concentrated particulate plume, a sampler can be located in either Zone A or B.

B-4



^aAPPLIES WHERE ADT > 3 000

Figure 1. Acceptable Zone for Siting PM₁₀ Monitors.

3.0 QUALITY CONTROL

Certain quality control checks exist to ascertain the precision and accuracy of the air monitoring system. First, the instrument is calibrated over its entire sampling range. Then, after the instrument has been operating for some time, steps are taken to make sure it stays in calibration.

3.1 CALIBRATION OF HIGH VOLUME SAMPLERS

E²M uses Hi-Vols equipped with a seven day timer, recording pressure transducers, flow controllers and sample savers. Samplers are calibrated when first purchased, quarterly, after major maintenance on the samplers, anytime the pressure transducer has been replaced or repaired, or when a one-point precision check deviates more than ± 6 percent from the calibration curve. E²M uses an orifice calibration unit with five different resistance plates. This unit is calibrated quarterly against a positive displacement primary standard.

3.2 CALIBRATION PROCEDURES INTRODUCTION

This section describes the step by step instructions for the calibration of each Hi-Vol air monitoring instrument used by E²M.

It is important that all information pertaining to the calibration be recorded. Proper recordkeeping will reduce the confusion later if data validity is questioned. The technician should clearly record enough information so that any person can understand exactly what happened during that calibration. Therefore, we provide AT LEAST the following information in the calibration book:

- o Station name
- o Type of check (Calibration, Precision Check, etc.)
- o Date
- o Your name (and anyone with you)
- o Time of day you start and finish
- o Monitor type and Serial Number
- o Calibration device
- o Temperature, Barometric Pressure and the Flow Correction Factor
- o Rotameter and/or Pressure settings on Calibration device
- o Comment on anything that may affect the calibration
- o Comment on any action(s) taken to alleviate a problem

3.3 FIELD CALIBRATION

3.3.1 APARATUS LIST

- o Manometer and Tygon Tubing
- o Calibration Orifice (and Plates if applicable)
- o Thermometer and Barometer
- o Calculator (LCD)
- o Calibration Curve (Chart or Equation)
- o Extra Dickson Charts and Filters
- o Notebook and Calibration/Audit Forms

3.3.2 SET-UP FOR CALIBRATION

3.3.2.1

Remove filter cassette from the Hi-Vol motor by loosening the 4 "wing nuts." Set it aside where it will not get damaged, dirty or affect the sample. Place a new chart on the Dickson Chart recorder.

3.3.2.2

Disconnect the Hi-Vol motor power at A (Figure 2) from the Sample Saver and Flow Controller. Unplug the Flow Controller at B. Plug in the Hi-Vol motor at B. Now the motor will operate without the Sample Saver or flow controller.

3.3.2.3

Place the orifice base on the top of the Hi-Vol motor (with no filter) and tighten down the 4 hold-down wing nuts to insure no leakage. Hang the Manometer on the Hi-Vol so that it is both level and easily read while making adjustments. Fill out the top of the Calibration/Audit sheet (Table 1) and calculate the correction factor as described.

3.3.3

Zero the Chart Recorder and Manometer. Check the "Zero" on the Chart Recorder. The pen should rest on the chart's zero when the Hi-Vol is off. If not, tap the chart recorder and, if necessary, adjust the "Zero Adjust" screw in the lower right corner. Next, check the Manometer's Zero. If both legs of the Manometer do not indicate a zero, adjust the scale so they will.

3.3.4 CALIBRATE THE HI-VOL MOTOR AND CHART RECORDER

3.3.4.1 ADJUSTABLE ORIFICE WITH NO PLATES

Turn on the Hi-Vol motor (at 1, Figure 2) and allow it to warm-up for 10 to 15 minutes. Adjust the knob on the top of the orifice to get a flow of approximately 50 scfm on the chart recorder. Make No adjustments to the Hi-Vol motor at this point. Record the following on the Calibration/Audit form (Table 1):

1. Manometer, Right and Left leg values

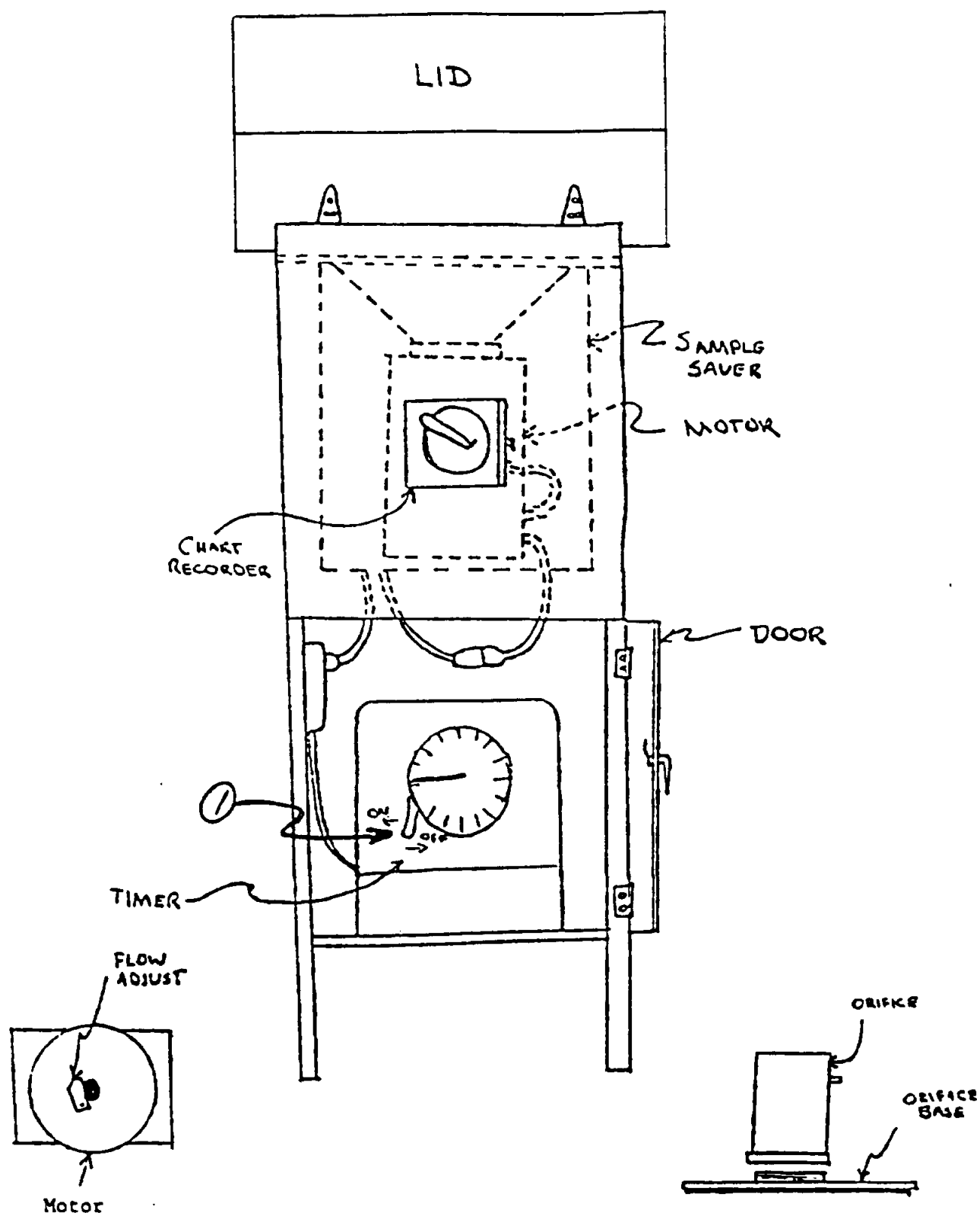


Figure 2. High Volume Air Sampler.

TABLE 1
HI-VOL CALIBRATION/AUDIT FORM

STATION NAME _____
STATION NO. _____
MOTOR NO. _____
COUNTY I.D. NO. _____
FLOW CONTROLLER yes no
GRFICE NO. _____

DATE _____
BAROMETRIC PRESS. _____ mm Hg
AMBIENT TEMP. _____ °C+273= _____ °K
CORRECTION FACTOR (CF) = _____
where $CF = \frac{\text{baro. press.}}{760} \times \frac{298}{\text{amb. temp. } ^\circ K}$

TECHNICIAN _____
COMMENTS: _____
SLOPE: _____ INTCP: _____
CORR. COEF: _____

PLATE NO. (88) FLOW CONT. 6 filter	MANOMETER ①		ΔH (A+B) ③	ΔH_{cor} ④ $\frac{\Delta H_{cor}}{\sqrt{\Delta H \times CF}}$	Q_{std} ⑥ from calibration curve (X) (SCFM)	Q_{cor} ⑤ $Q_{meas} \times \sqrt{CF}$ (Y) (SCFM)	Q_{meas} ② from Dickson chart (CFM)	Z DEV ⑦ $\frac{Q_{cor} - Q_{std}}{Q_{std} \times 100}$
	(A) RIGHT LEG (in.)	(B) LEFT LEG (in.)						
NO								
ADJ.								
13								
ADJ								
13								
ADJ								
13								
18								
10								
7								
5								

2. Q_{meas} from Dickson Chart Recorder

Calculate and record the following:

3. $\Delta H = \text{Right plus Left legs}$
4. $\Delta H = \sqrt{\Delta H \times CF}$
5. $Q_{\text{cor}} = Q_{\text{meas}} \times \sqrt{CF}$
6. $Q_{\text{std}} = \text{from calibration curve of orifice}$
7. $\% \text{ Dev} = \frac{Q_{\text{cor}} - Q_{\text{std}}}{Q_{\text{std}}} \times 100$

3.3.4.2

If the % Dev exceeds $\pm 2.0\%$, adjust the Motor Flow Adjust (Figure 2). Calculate and record the values (as described above). Check the % Dev and repeat this procedure until the % Dev drops below 2.0% and then make no further adjustments. Adjust the orifice knob to generate 3 additional flows (open wide, 40 cfm and 30 cfm) on the chart recorder. Calculate and Record the values as described above.

3.3.4.3 ORIFICE USING PLATES

Put plate #13 (13 holes) on the base of the orifice. Install the top half of the orifice and tighten enough to eliminate leakage. Turn on the Hi-Vol motor (at 1, Figure 2) and allow it to warm for 10 to 15 minutes. Record the following on the Calibration/Audit Form (Table 1):

1. Manometer, Right and Left leg values
2. Q_{meas} from Dickson Chart Recorder

Calculate and record the following:

3. $\Delta H = \text{Right plus left legs}$
4. $\Delta H = \sqrt{\Delta H \times CF}$
5. $Q_{\text{cor}} = Q_{\text{meas}} \times \sqrt{CF}$

6. Q_{std} = from calibration curve of orifice

7. $\% \text{ Dev} = \frac{Q_{cor} - Q_{std}}{Q_{std}} \times 100$

3.3.4.4

If the $\% \text{ Dev}$ exceeds $\pm 2.0\%$, adjust the Motor Flow Adjust (Figure 2). Calculate and Record these new values (as described above). Check the $\% \text{ Dev}$. Repeat this procedure until the $\% \text{ Dev}$ drops below 2% and then make no further adjustment to the motor. Turn off the motor and install the 18 hole plate and calculate the above values. Follow the same procedure for the 10, 7 and 5 hole plates.

3.3.5

The calibration is completed. Remove all calibration equipment. Reinstall the filter cassette and remove the chart from the recorder used for the calibration. Reconnect the Flow Controller and the Sample Saver. Check the Hi-Vol timer and set, if necessary. The Hi-Vol should be set-up for the next run.

3.3.6 ADJUST THE FLOW CONTROLLER

Turn on the PM_{10} and allow it to warm-up for 10 to 15 minutes. Check the flow on the Chart recorder. If the flow falls between 38 and 42 scfm, make no adjustments. If the flow is not within this range, adjust the Flow Controller at the flow adjust potentiometer until it does fall between 38 and 42 scfm.

3.3.7

Close the Hi-Vol lid and doors. Make notes in your notebook about the calibration (weather conditions, orifice used, any problems, etc.). Turn over your notebook to your Supervisor at E²M.

4.0 PROCESSING FIELD SAMPLES

Filters removed from the PM₁₀ monitor are folded and placed in a pre-addressed and stamped envelope and sent to Hazen Research in Golden, Colorado for weighing. Hazen Research provides pre-weights on all of E²M's numbered filters. Post-weights are provided from Hazen Research and listed by E²M number.

5.0 NETWORK OPERATION

Routine data collection, as well as preventive maintenance procedures, is conducted to assure collection of high quality data.

Field sampling of PM_{10} at the ORMET Site will involve specific collection and analysis procedures described below. (Field technicians carefully follow these collection procedures to provide samples for analysis by E³M's subcontractors).

Field technicians are furnished with pre-conditioned, numbered Hi-Vol filters prepared by Hazen Research, Inc., Golden, Colorado. They visually inspect the Hi-Vol filter holder gasket and the filter holder itself before placing the unexposed filter under the gasket. The technicians then install the new filter and set the automatic timer to start the Hi-Vol. The EPA sixth-day schedule is followed. All pertinent information is noted on the Daily Hi-Vol Data Record form (Figure 3). This information includes site location, site name, sampler serial number, filter number, date and starting time of the Hi-Vol run. Any unusual conditions which may affect the sample are noted on the form.

Once the filter has been exposed, the field technician completes the Daily Hi-Vol Data Record form with the stop date and time and the summary of any unusual conditions which may have affected the sample. The technician carefully removes the filter and inspects it for signs of leaks, improper installation or damage. The filter is folded and inserted into the data folder for transport to the Hazen Research, Inc. laboratories. The form is constructed of heavy gauge paper which serves to protect the filter during transport. The flow rate chart is also removed. The filter folder is marked void by the technician and held subject to quality assurance review if any problems are noted that would invalidate the sample.

DAILY HI VOL DATA RECORD			
CITY & STATE _____			
SITE NAME _____			
TYPE OF SAMPLER _____			
SAMPLER SERIAL NUMBER _____			
FILTER NUMBER _____			
RUN DATE: _____		<div style="border: 1px solid black; padding: 2px; font-size: 0.8em;"> FOR LAB USE ONLY () CFM () CFM </div>	
MONTH DAY YEAR			
SAMPLE TIME: _____			
COUNTER: END _____			
COUNTER: BEGIN _____			
MINUTES SAMPLED _____			
FIELD NOTES: _____			

COLLECTED BY _____			
FOR LAB USE ONLY:			
PARTICULATE DATA			
GROSS WGT. FILTER _____ (GRAMS)			
TARE WGT. FILTER _____ (GRAMS)			
PARTICULATE WGT. _____ (GRAMS)			

Figure 3. ~~4-53~~ Daily Hi-Vol Data Record Form.

Laboratory analysis for PM₁₀ is performed at the laboratories of Hazen Research, Inc., Golden, Colorado. High-volume filters are analyzed by EPA-approved methods contained in 40CFR Part 50, Appendix J. PM₁₀ is determined gravimetrically by weighing the filters before and after exposure. Prior to weighing, both exposed and unexposed filters are conditioned in a constant low relative humidity environment (R.H. <50%) and ambient temperature (15° to 35°C) for 24 hours. This procedure is detailed on page B-16.

Hi-Vol filter analyses reports are prepared by Hazen Research, Inc. PM₁₀ is reported in grams. The following calculations are made to determine the respective concentrations in ug/m³ that these weights represent:

Method for Calculation of PM₁₀ concentrations

based on

weight of PM₁₀ on Hi-Vol filter - reported in grams,

flow rate of air through filter - reported in CFM

duration of sample - reported in minutes

ft³ converted to m³ - 0.028317 x ft³ = m³

concentration in ug(PM₁₀)/m³

$$\frac{\text{g} \times 10^6}{\text{CFM} \times 0.028317 \times \text{minutes}} = \text{ug PM}_{10}/\text{m}^3$$

Hazen Research, Inc.
Analytical Procedure

Procedure for Conditioning and Weighing
Hi-Vol Filter Papers

1. Examine new filters for pinholes, creases, or other imperfections by viewing them on a light table. Discard any that are flawed.
2. Number each filter paper according to client specifications, using an indelible ink pen.
3. Equilibrate the filters in the balance room, maintained at 15° to 35° C, for 24 hours. At no time during this period should the relative humidity of the room exceed 50%. The filters must be re-equilibrated if the relative humidity exceeds 50%.
4. Without folding, creasing, or bending the filters, weigh them to the nearest 0.1 milligram and record the weight and filter number on the data sheet.
5. Re-package the filters, using a piece of onion skin or similar sheet between the papers to prevent contact between filters. Do not fold, crease, or bend the papers prior to use.
6. When re-weighing used filters, equilibrate them in similar fashion as with new filters.
7. Weigh the used filters to the nearest 0.1 milligram and record the weight and filter number on the data sheet.
8. Return filters to their containers for storage or later return to client.

Figure 4. Hazen Research, Inc. Procedure for Conditioning and Weighing Hi-Vol Filter Papers.

**PHASE I REMEDIAL INVESTIGATION
WORK PLAN**

4.0 SITE HEALTH AND SAFETY PLAN

Section

4.0 SITE HEALTH AND SAFETY PLAN (SOW TASK 2-B)

4.1 INTRODUCTION

Geraghty & Miller, Inc. (G&M) is the consulting firm selected by Ormet and approved by U.S. EPA and OEPA to direct and supervise all work to be performed pursuant to the Consent Order. G&M has developed this Site Health and Safety Plan (HASP) which is designed to protect the health and safety of personnel involved in the remedial investigation (RI) of the Ormet facility. The location of the facility is shown on Figure 4.1-1. The plan also addresses health and safety procedures for site visitors. Safety and health procedures covering the performance of the following tasks are included. The work areas in which these tasks are to be performed are shown in Figure 4.1-2.

4.1.1 Phase I Site Investigation

4.1.1.1 Disposal Pond Waste Characterization (SOW TASK 3-A)

Disposal Ponds 1 through 5 will be characterized by the following methods:

- ♦ Sludge sampling employing hand augers and/or specialized sludge sampling devices;

FIGURE 4.1-1 General location of Ormet Corporation plant site.
Hannibal, Ohio

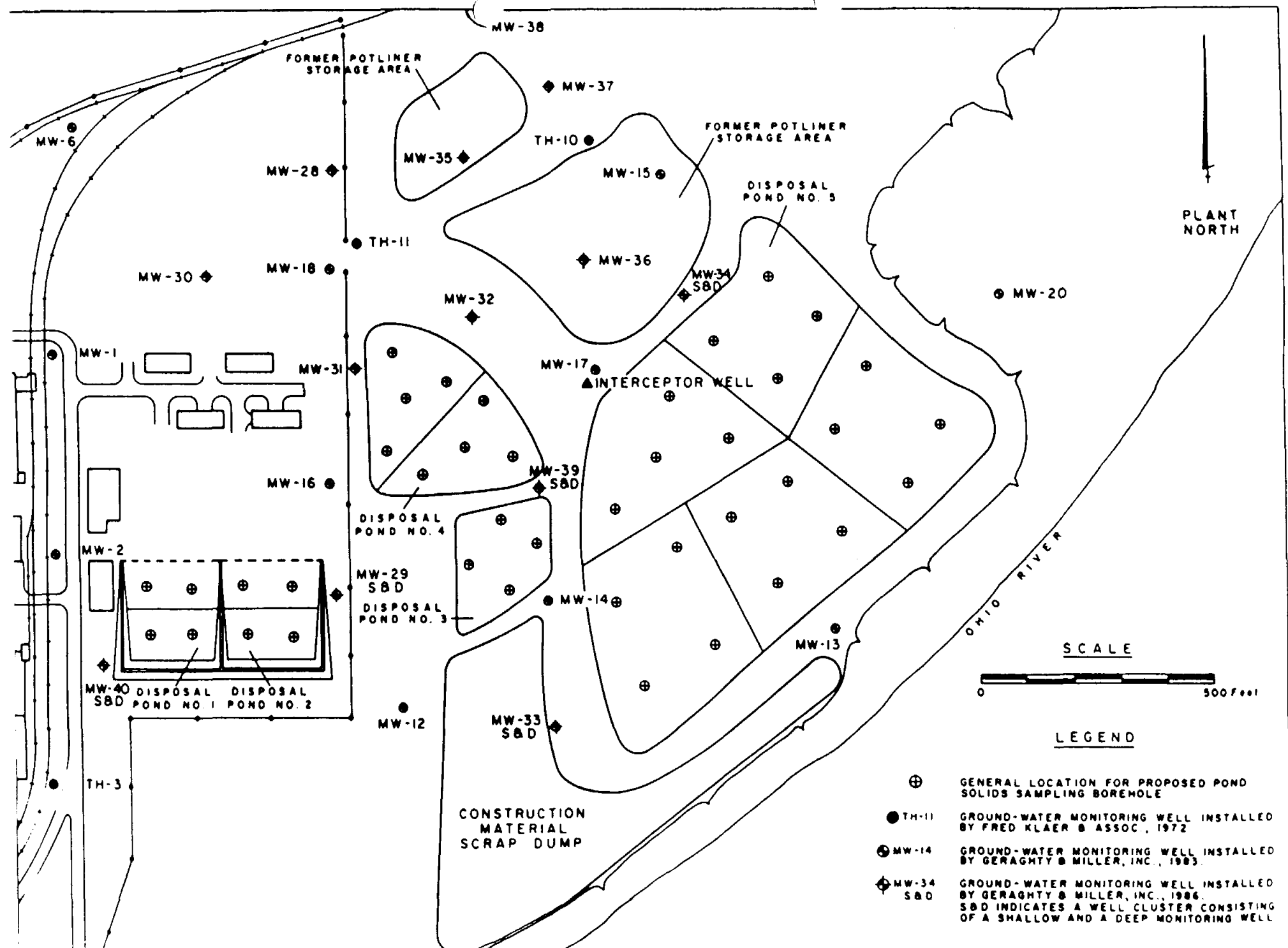


FIGURE 4.1-2

General locations of soil boring and sampling points.

Ormet Corporation, Hannibal, Ohio

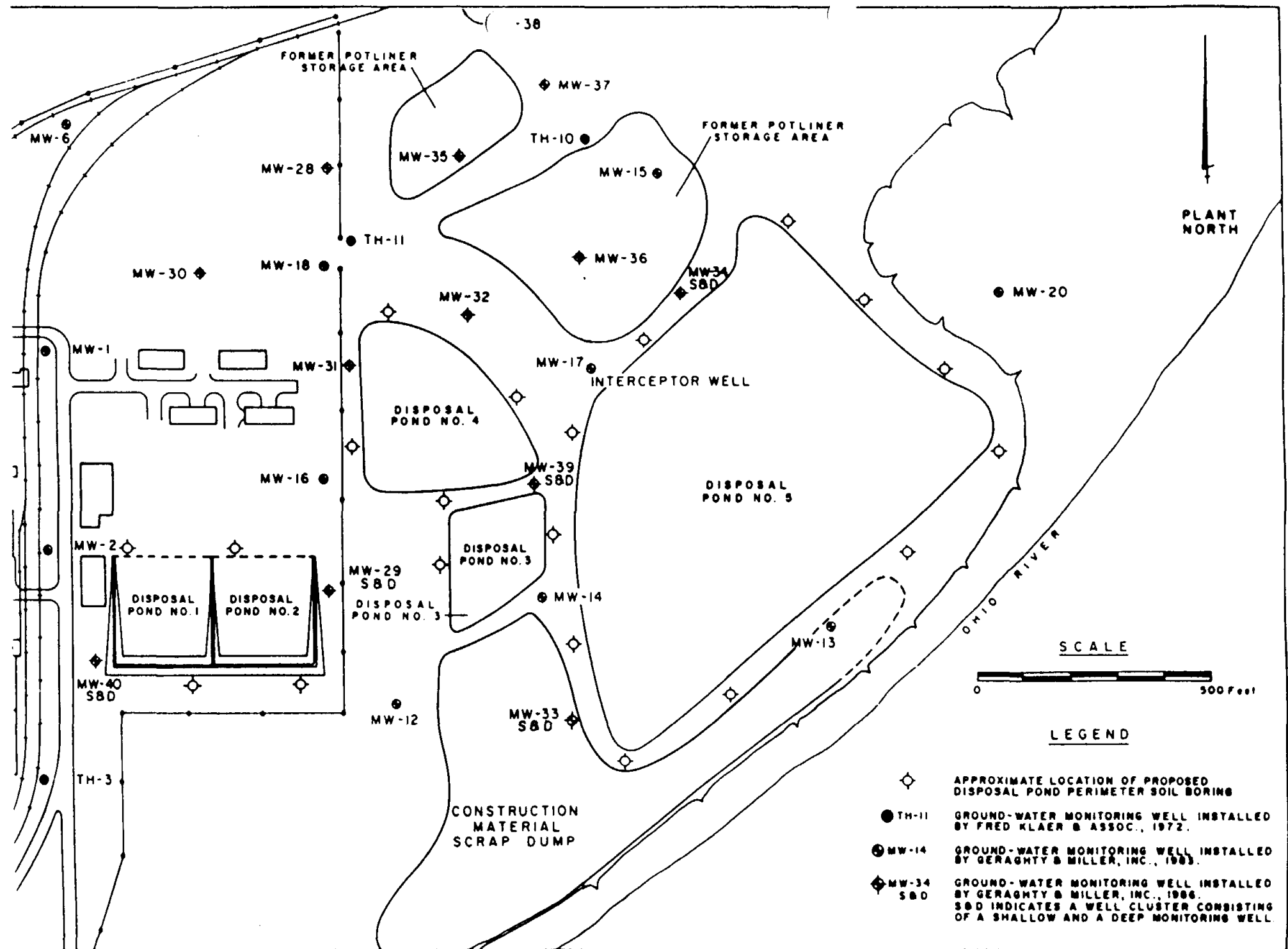


FIGURE 4.1-2 (cont.) General locations of soil boring and sampling points.
Ormet Corporation, Hannibal, Ohio

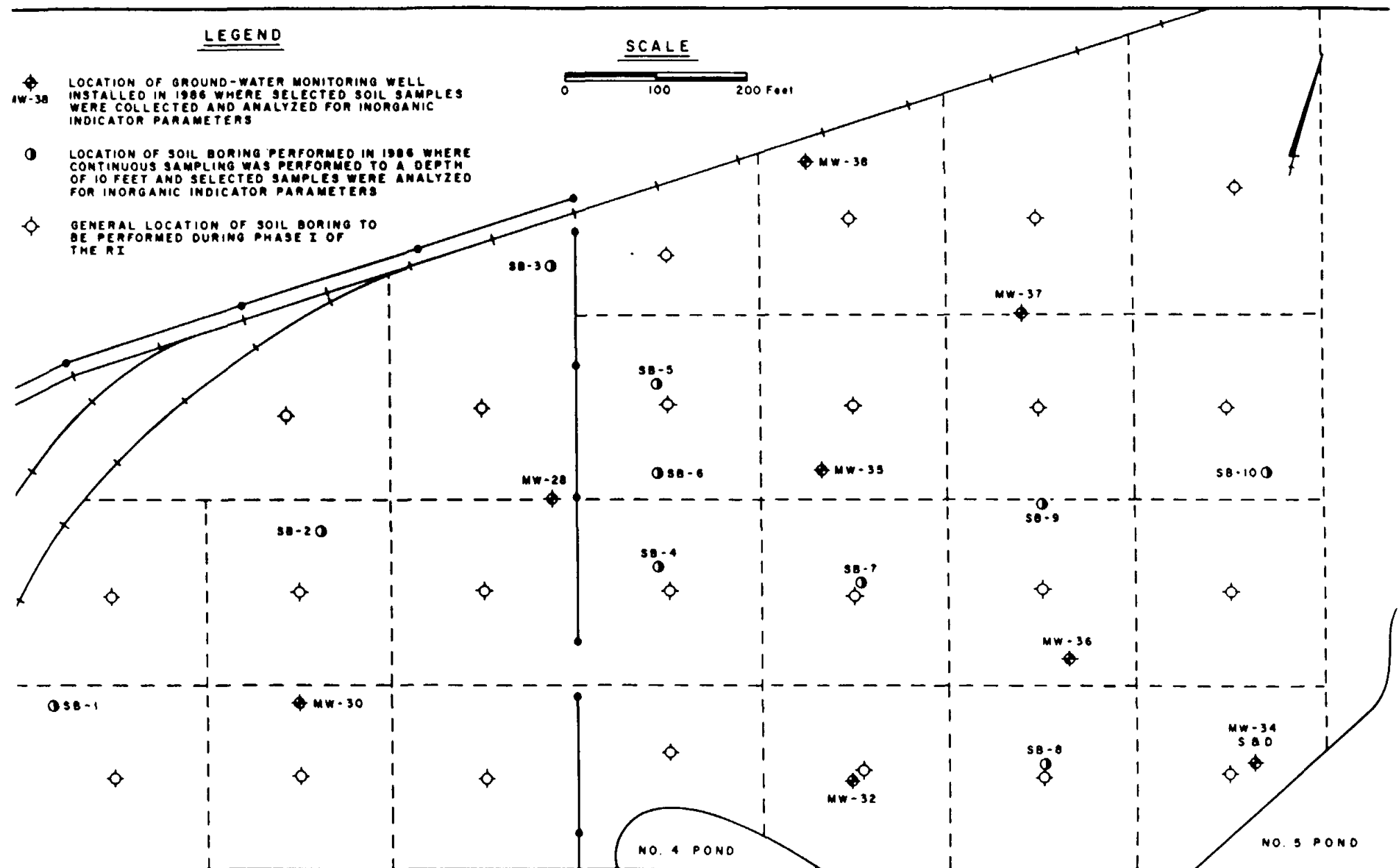


FIGURE 4.1-2. (cont.) General locations of soil boring and sampling points.

Ormet Corporation
Hannibal, Ohio

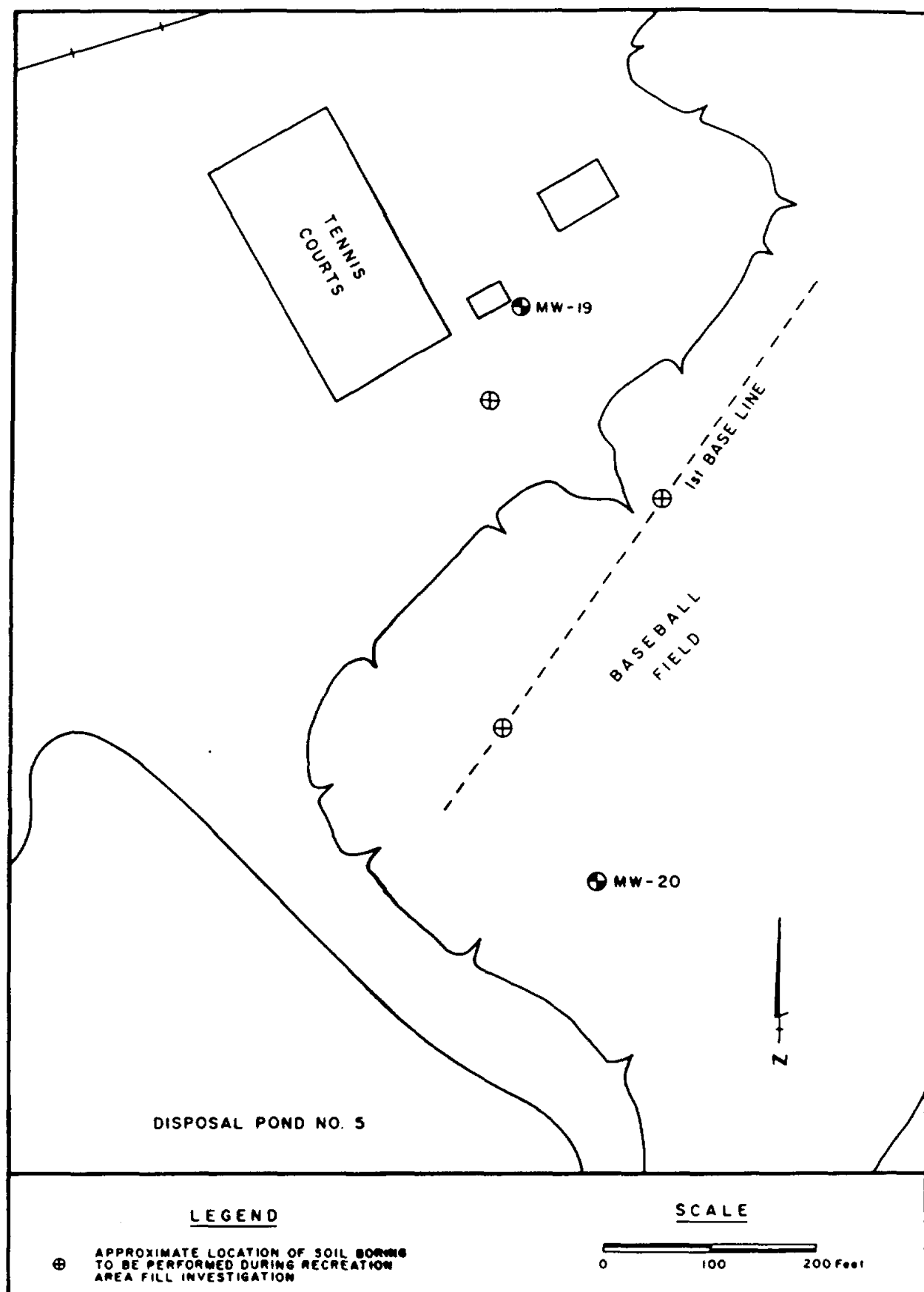


FIGURE 4.1-2 (cont.) General locations of soil boring and sampling points.

Ormet Corporation

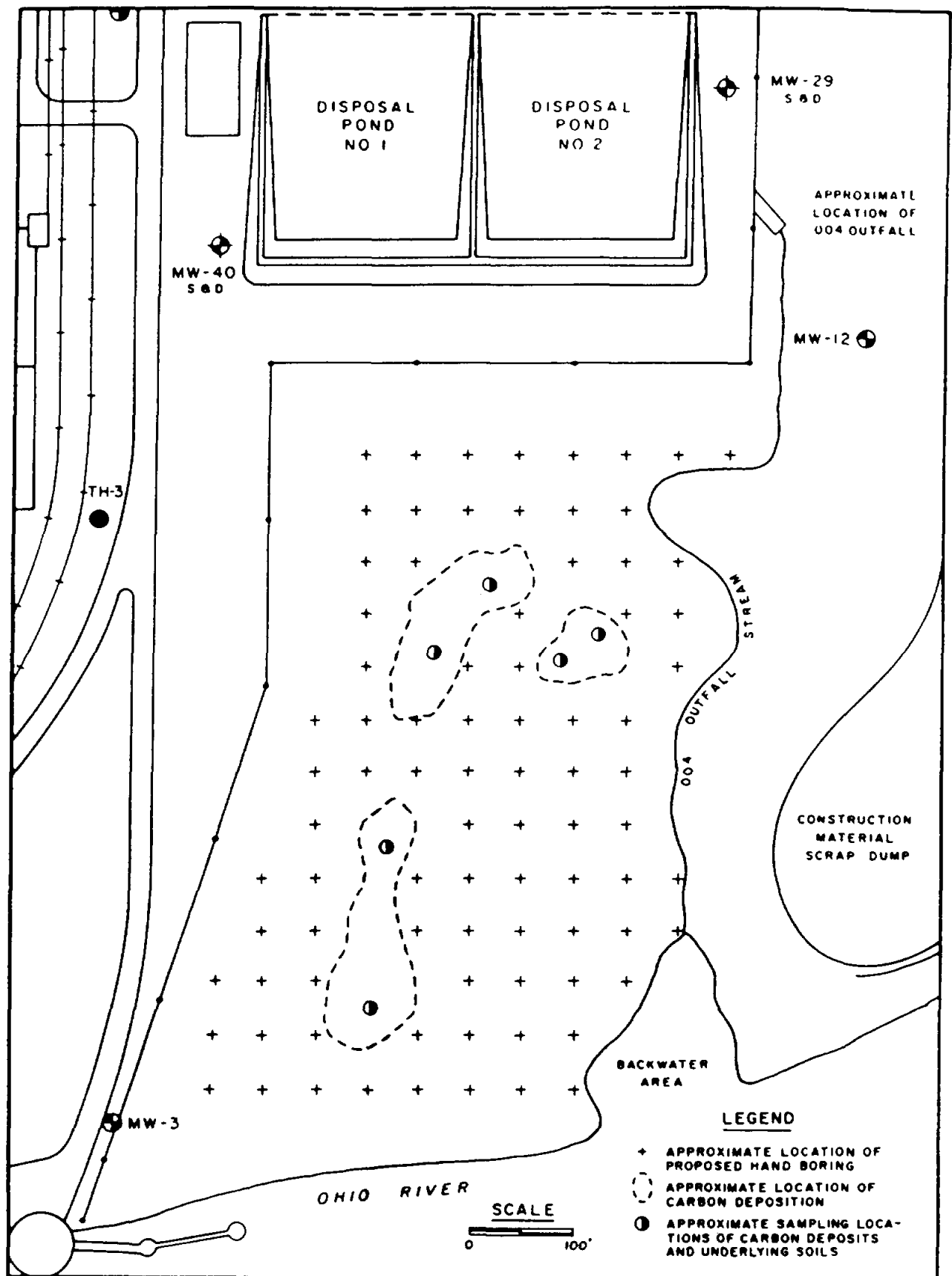


FIGURE 4.1-2 (cont.) General locations of soil boring and sampling points.

Ormet Corporation
Hannibal, Ohio

- ♦ Infiltration rate determination for each pond via double ring infiltrometer;
- ♦ Perimeter soil borings via hollow stem auger (HSA) drilling methods; and
- ♦ Chemical analysis of selected samples of pond sludge

**4.1.1.2 Waste Potliner Storage Area Characterization
(SOW TASK 3-B)**

The waste potliner storage area will be characterized via shallow soil borings, installed via HSA. Selected soil samples will be submitted for chemical analysis.

4.1.1.3 Seep Sampling (SOW TASK 3-C, 3-I, and 3-J)

Surface water samples will be collected from the following areas:

- ♦ Surface seeps adjacent to the construction material scrap dump;
- ♦ Drainage culvert near Pond 5; and
- ♦ Surface seeps near the recreation area

4.1.1.4 Ohio River Sediments Characterization (SOW TASK 3-D)

Bottom sediments shall be collected for chemical analysis from six sample locations along the Ohio River.

4.1.1.5 Monitoring Well Installation (SOW TASK 3-E)

Three additional monitoring wells will be installed via HSA at the following general locations:

- ♦ Near monitoring well MW-12
- ♦ West of Pond 3
- ♦ Southeast of monitoring well TH3

4.1.1.6 Ground-Water Sampling (SOW TASK 3-F)

Ground water samples from all existing monitoring wells plus the additional wells installed under 4.1.1.5, above will be collected and analyzed.

4.1.1.7 Carbon Runoff and Deposition Area (SOW TASK 3-G)

Hand augering of shallow borings on a grid pattern will be performed within this area, with collection of selected carbon sludge/soil samples.

4.1.1.8 Air Monitoring (SOW TASK 3-H)

An air monitoring program via high volume type samplers will be conducted.

4.1.1.9 Plant Recreation Area Waste Investigation (SOW TASK 3-J)

Three (3) borings will be installed via HSA.

4.2 HEALTH AND SAFETY PLAN ENFORCEMENT

The G&M SSO or his designee will monitor adherence to the HASP during the investigation, and will ascertain that all work is performed in accordance with the health and safety requirements described herein. RI-related work at the Ormet site shall be performed in accordance with OSHA 29 CFR Part 1910.120 "Hazardous Waste Operations and Emergency Response", and applicable Federal, State and local health and safety regulations.

The following personnel or their designee will be responsible for implementation, maintenance, and enforcement of all aspects of the HASP program for this project:

Robert L. Fargo, G&M Project Manager

Timothy T. Ratvasky, G&M Site Safety Officer

J.D. Reggi, Ormet Project Coordinator

The SSO will coordinate and monitor the safety-related aspects of the RI field program at startup, and will conduct approximately weekly inspections of the worksite and ongoing activities. The SSO may appoint a designee to perform these

inspections. The Site Safety Officer (SSO) or his designee has the option to implement requirements in addition to those described here in on a case-by-case basis. Should an unforeseen or site-specific safety related factor, hazard or condition become evident during the investigation, actions will be taken to reestablish safe working conditions and to safeguard site personnel, the public, and the environment. Actions taken to safeguard workers beyond those measures described in this plan will be verbally communicated to G&M personnel and subcontractors prior to implementation and will be submitted in writing at the request of its subcontractors.

4.3 SITE SECURITY

All persons must be approved by the Ormet Project Coordinator or his designee for entry to areas in which work is being performed under the RI Work Plan. All persons entering work areas which require respiratory protection must meet medical surveillance and training criteria set forth in this document, as enforced by the SSO. The SSO or his designee has the responsibility for final site entry approval and for removal of unauthorized personnel, through the aid of Ormet security personnel. Plant entry procedures and rules are outlined in Attachment 4-A.

Entry to and exit from the Ormet site is restricted to the main plant gate, where Ormet security personnel monitor all individuals entering and leaving the plant. Ormet security personnel will be notified in the event of any unauthorized entry and will take appropriate measures to remove unauthorized individuals.

4.4 POTENTIAL CONTAMINATION SOURCES AND WASTE CHARACTERIZATION

Data from previous investigations at the Ormet site indicate that the potentially harmful substances which could be encountered during the RI include hydrogen cyanide, hydrogen fluoride and selected polynuclear aromatic hydrocarbons (PAH's). The toxicological, human health, and safety information for these substances are presented in Table 4.4-1. Supporting data are given in Attachment 4-B.

4.4.1 Potential for Exposure

As a result of previous investigations conducted at the site by G&M, an extensive database has been compiled including laboratory analysis of pond solids and former potliner area soils, and ground-water quality information. These data show that free cyanide exists at this site only under highly alkaline conditions ($\text{pH} > 8$), which prevents the generation of hydrogen cyanide gas. Likewise, highly alkaline subsurface conditions preclude the formation or existence of hydrogen fluoride in either soil or ground water. Thus, based upon existing knowledge of the Ormet site, the potential for exposure to hydrogen cyanide and hydrogen fluoride during RI activities is limited.

In order to provide protection for RI personnel, monitoring for both hydrogen cyanide and hydrogen fluoride will be performed during field sampling activities, as outlined in Section 4.7.

4.4.2 Exposure Pathways

As outlined in Table 4.4-1, the principal exposure pathways for hydrogen cyanide, hydrogen fluoride, and PAH's are via dermal contact and inhalation during drilling and/or sampling in contaminated source materials or ground water. Odor thresholds for HF and HCN are relatively low (see Table 4.4-1).

Atmospheric monitoring in work areas, coupled with respiratory protection where needed, will be employed. The degree of respiratory protection to be adopted will be dependent upon monitoring results and the tasks to be performed, but may consist of full-face air purifying respirators (A.P.R.'s) or pressure demand-type self contained breathing apparatus.

TABLE 4.4-1

SUBSTANCES OF HEALTH AND SAFETY CONCERN

HYDROGEN CYANIDE

SYNONYMS:	Hydrocyanic acid, Prussic acid, Formonitrite
PERMISSIBLE EXPOSURE LIMIT:	10 ppm (11 mg/m ³) (OSHA) 4.7 ppm (5mg/m ³) 10 min. ceil. (NIOSH) 10 ppm (10/mg/m ³) ceil. (ACGIH)
IDLH LEVEL:	50 ppm
ODOR THRESHOLD	1 mg/m ³
PHYSICAL DESCRIPTION:	Colorless or pale blue liquid or gas with a bitter almond odor
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 4.8 Protective Clothing: Required Goggles: Required Wash: Immediately upon contamination Change: N/A Remove: Any wet clothing immediately (flammable) Provide: eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, adsorption, ingestion, contact
SYSTEMS:	Asphyxia and death at high levels; weak, headache, confusion, nausea, vomiting; increase rate & depth of respiration or respiration slow and gasping
FIRST AID:	Eye: Irrigate immediately Skin: Water flush immediately Breath: Artificial respiration/ use Amyl Nitrite Pearls Swallow: Drink water, force vomit
TARGET ORGANS:	CNS, CVS, liver, kidneys
FLAMMABILITY	Lower Explosive Limit: 5.6% Upper Explosive Limit: 40%

TABLE 4.4-1 (continued)

HYDROGEN FLUORIDE

SYNONYMS:	Anhydrous hydrofluoric acid; HF-A
PERMISSIBLE EXPOSURE LIMIT:	3 ppm (OSHA, ACGIH) 6 ppm 15 min. ceil. 3ppm 10 hr. TWA (NIOSH)
IDLH LEVEL:	30 ppm
ODOR THRESHOLD	0.03 mg/m ³
PHYSICAL DESCRIPTION:	Colorless, fuming liquid or gas with a strong, irritating odor
PERSONNEL PROTECTION AND SANITATION	Respiratory Protection: Required, see Section 4.8 Protective Clothing: Required Goggles: Required Wash: Immediately upon contamination non-imperv. Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, adsorption, ingestion, contact
SYMPTOMS:	Eye, nose, throat, irrit; pulmedema; skin, eye burns, nasal congestion, bronchial irritation
FIRST AID:	Eye: Irrigate immediately Skin: Water flush immediately Breath: Artificial respiration Swallow: Water, NO VOMIT
TARGET ORGANS:	Eyes, respiratory system, skin lungs
FLAMMABILITY:	Not Combustible

TABLE 4.4-1 (continued)

POLYNUCLEAR AROMATIC HYDROCARBONS

SYNONYMS:	Polynuclear aromatics, i.e., Fluoranthene, Napthalene
PERMISSIBLE EXPOSURE LIMIT:	200 ug/m ³ (OSHA) 100 ug/m ³ (NIOSH)
IDLH LEVEL:	N/A
PHYSICAL DESCRIPTION:	Yellowish crystalline solid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 4.8 Protective Clothing: Required Goggles: Required Wash: Immediately upon contact Change: N/A Remove: Any wet clothing immediately Provide: Eyewash, quick drench
SYMPTOMS:	Lung irritation
FIRST AID:	Eye: Irrigate immediately Skin: Water and soap Breath: Artificial respiration
TARGET ORGANS:	Skin, lungs (carcinogens)
FLAMMABILITY:	Varies with Compound

Absorption via dermal pathways may occur if contact is made with fluids or solids containing PAH, HCN or HF. Protective garments to be employed within work areas and contamination reduction areas will be resistant to these substances; protective garments and measures are outlined in the following sections.

4.4.3 Health Effects

Cyanide affects the cardiovascular and central nervous system, kidneys and liver. Exposure to high cyanide levels via ingestion or inhalation leads to unconsciousness, cessation of breathing and possibly death. At low exposure levels ($>5 \text{ mg/m}^3$, 10 ppm) headache, confusion and nausea may be experienced. Early warning signs of exposure are; headache, nausea, weakness and dizziness.

Hydrogen fluoride in either a liquid or gas form produces severe, acute damage to the skin, eyes, and respiratory tract. Its irritating odor normally prevents voluntary inhalation of toxic quantities. However, serious burns and blindness may occur upon skin or eye contact with hydrofluoric acid liquid.

Collectively, polynuclear aromatic hydrocarbons are an eye, skin, and respiratory irritant with good warning properties.

The principal exposure pathway is primarily via dermal contact and ingestion. Some PAH compounds are toxic in large doses (i.e., Naphthalene) and may be carcinogenic (acenapthalene). Protective clothing and equipment (i.e., goggles and respirators) will supply adequate protection against PAHs.

4.4.4 Physical Hazards

Considering the documented conditions at the Ormet site, physical hazards associated with drilling and sampling activities are seen as presenting a greater potential for injury than chemical exposure.

Injuries which may result from physical hazards existing on a worksite include;

- ♦ slip-trip-fall type of accidents;
- ♦ back injuries due to improper lifting;
- ♦ casualties resulting from being caught in moving or rotating drilling equipment;
- ♦ electrocution hazards associated with drill rig mobilization; i.e., contact with overhead/underground power lines;
- ♦ Operation of improperly maintained equipment.

Injuries resulting from physical hazards can be avoided through the adoption of safe work practices and employing caution when working with machinery. The following precautions will help prevent injuries due to physical hazards:

- ♦ only experienced and qualified operators and helpers will be permitted to operate drilling equipment;
- ♦ all nonessential people will be prohibited from entering work areas;
- ♦ frequent (daily) inspections of drilling equipment and operating methods will be performed and repairs done as necessary;
- ♦ orderly work areas will be maintained whenever possible;
- ♦ work zones will be observed and the buddy system employed;
- ♦ hard hats and protective footwear will be worn when performing RI tasks;
- ♦ checks will be performed for overhead and underground utilities before entering new work areas;
- ♦ drilling equipment and vehicles will be refueled only within safe areas and with equipment shut off.
- ♦ loose fitting clothing will not be worn when operating drilling equipment.

4.5 DETERMINATION OF WORK AREAS

G&M will define and identify the following areas at the work site and specify the equipment, operations, and personnel in the areas, as defined below.

4.5.1 Zone 1: Exclusion Zone

The exclusion zone is the zone where contamination exists or could occur. All people working within an exclusion zone/work area will wear the prescribed level of protection. An entry and exit check point will be visually defined at the periphery of the exclusion zone(s) to regulate the flow of personnel and equipment into and out of the zone.

Prohibitions in the Exclusion Zone would include the following:

- ♦ Beards and long sideburns;
- ♦ Eating, smoking, chewing;
- ♦ Personal articles, e.g., watches and rings;
- ♦ Working when ill; and

- ♦ Completely removing respirator under full level C protection, when such protection is required

4.5.2 Zone 2: Contamination Reduction Zone

The area between the exclusion zone and the support zone is the contamination reduction zone (CRZ). This zone provides a transition between a contaminated area and the clean zone. The CRZ serves as a buffer to further reduce the possibility of the clean zone becoming contaminated. It provides additional assurance that the physical transfer of contaminating substances on people, equipment, or in the air is limited through a combination of decontamination, distance between exclusion and support zones, air dilution, zone restrictions, and work functions. At the boundary between the exclusion and contamination reduction zones, decontamination stations will be established, as described in the decontamination procedures.

4.5.3 Zone 3: Support Zone

This area is outside the zone of contamination. The support zone shall be marked and protected against contamination

from the work site. The function of the area includes:

- ♦ An entry for personnel, material, and equipment;
- ♦ An exit area for decontaminated personnel, materials and equipment;
- ♦ A storage area for clean safety and work equipment; and
- ♦ An area for rest breaks, the consumption of food and beverage, and all other activities

The general relationship among the site work zones is depicted in Figure 4.5-1. During this investigation, exclusion zones will be identified, where possible, by the unit being investigated, i.e., individual disposal ponds and waste potliner storage area will each constitute an exclusion zone with a single, centrally located CRZ.

Due to the limited area involved for certain drilling and sampling tasks, work areas outside of visually defined exclusion areas (i.e. soil sampling and monitoring, well installation and sampling locations outside of disposal ponds and potliner storage area, etc.) will be cordoned off via fluorescent cones during the performance of the required task. Activities and

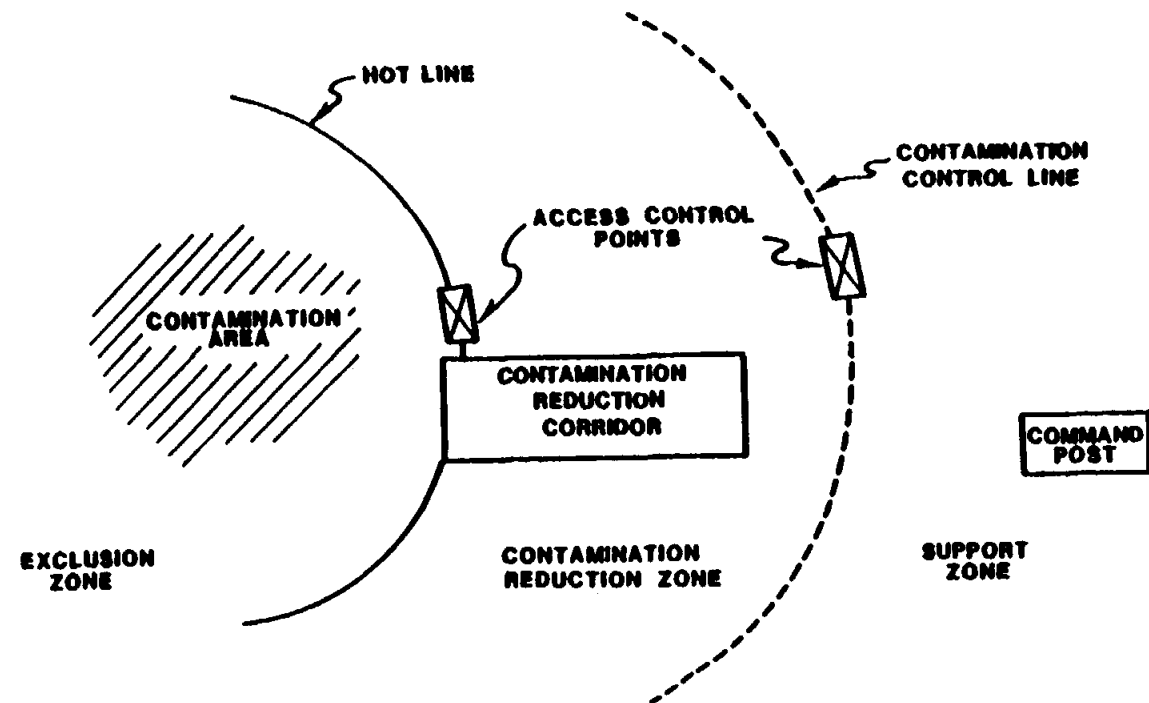


FIGURE 4.5-1 **DIAGRAM OF SITE WORK ZONES**

resulting waste productions (cuttings, etc.) will be contained within these work areas and properly disposed of. Only authorized investigative team members and individuals will be allowed within work areas during the field work. Site security will be performed by the SSO or his designee and plant security personnel.

4.6 ZONE PERSONAL PROTECTION REQUIREMENTS

Selection of personal protective equipment for the exclusion zone work areas is based upon OSHA requirements for each task. Protective gloves, boots, and suits will be of material resistant to the acids and organic chemicals present. All respiratory protective equipment will be approved by the National Institute for Occupational Safety and Health (NIOSH).

The recommended levels of personal protection and work area monitoring are presented for each task in Table 4.6-1. The recommended levels of protection are based upon existing soil, sludge, and ground-water quality data collected during previous investigations. Protection levels may be up- or downgraded, as deemed necessary by the SSO or his designee, based on work area monitoring (respiratory protection level) and/or visual inspection.

4.6.1 Level C Protection

- ♦ Full-face, air-purifying respirator
- ♦ Work clothes

TABLE 4.6-1
WORK TASKS TO BE PERFORMED
AND CORRESPONDING LEVEL OF PROTECTION

Task/Area	Monitoring (1) Parameters	Level of (2) Protection
Disposal Pond Waste Characterization		
♦ Perimeter Borings	1,2,3	C ⁽³⁾
♦ Sludge Sampling	1,2,3	C ⁽³⁾
♦ Infiltrometer Testing	1,2,3	D
Waste Potliner Storage Area Characterization	1,2,3	C ⁽³⁾
Seep Sampling		
♦ Construction Material Scrap Dump	1,2	D
♦ Drainage Culvert	1,2	D
♦ Recreation Area Surface Seeps	1,2	D
Ohio River Sediments Characterization		D
Ground-Water Sampling	1,2,3	C ⁽³⁾
Carbon Runoff and Deposition Area	1,2,3	D
Monitoring Well Installation		
♦ Near Well TH3	1,2,3	C ⁽³⁾
♦ West of Disposal Pond 3	1,2,3	C ⁽³⁾
♦ West of Construction Material Scrap Dump	1,2,3	C ⁽³⁾
Plant Recreation Area Waste Investigation	1,2,3	D

(1) 1= Hydrogen Cyanide (2) Level of protection to be employed
 2= Hydrogen Fluoride will be dependent upon results of
 3= Organic Vapors work area monitoring program, and
 up or downgraded, as necessary,
 by the SSO or his designee

(3) Air purifying respirators will
 be kept at the work areas during
 field operations. Use of respirators
 will be based upon the action levels
 given in Table 4.7-1.

- ◆ Tyvek chemical-resistant clothing (Tyvek, Poly-coated, Saranex), long sleeves, one piece. Requirement for hood to be determined

- ◆ Gloves
 - Inner-chemical resistant, PVC
 - Outer-chemical resistant, Nitrile

- ◆ Boots
 - Chemical-resistant to substances of concern
 - Steel toe

- ◆ Eye protection
 - Safety glasses when above the water table
 - Goggles when handling/collecting wet soil/sludge samples and water

- ◆ Hard hat (face shield optional)

- ◆ Boot, coverall and outer glove joints will be sealed with duct tape, as required by site conditions

Level C protection will be employed for work-area tasks except during specific low-hazard activities where level D protection is specified. Level C protection will be upgraded by the Site Safety Officer, if found to be necessary by work area monitoring results. Full-face, air purifying respirators (A.P.R.'s) may be required for work in level C areas, as determined by monitoring. A.P.R.'s will be kept on-hand during all level C activities.

4.6.2 Level D Protection

- ♦ Coveralls (Tyvek, Poly-coated)
- ♦ Gloves
 - o Outer-Nitrile
 - o Inner-PVC
- ♦ Boots
 - o Steel toe
 - o Chemical resistant to substances of concern
- ♦ Goggles or safety glasses
- ♦ Hard hat

4.7 PERMISSIBLE EXPOSURE LIMIT (PEL) PROVISIONS

4.7.1 Inhalation

Employee or subcontractor exposure to airborne concentrations of PAH's, hydrogen cyanide and hydrogen fluoride throughout the course of the investigation shall be controlled through the use of air monitoring equipment and properly used respiratory protective equipment. In the event that the personal protection level is upgraded to require respiratory protection, workers within the work areas(s) will be supplied with air purifying respirators equipped with an appropriate cannister or cartridges (see Section 4.8). Cannisters or cartridges used at full level C protection will be discarded upon loss of filtration efficiency, and fresh cannisters or cartridges will be installed. A record of the usage of each cannister will be maintained by the user as an additional means of determining the useful life of their respirator cannisters.

The periodic evaluation of the breathing zone will provide readings for organic vapors, hydrogen cyanide, and hydrogen fluoride to support the appropriateness of the protection level.

Selection of detector-tube-type air monitors for the detection of hydrogen cyanide and hydrogen fluoride is based

primarily upon extensive existing site data which indicate limited potential for hydrogen cyanide generation and little to no potential for encountering hydrogen fluoride on the Ormet site. The frequency of breathing zone monitoring will be as follows:

- ◆ Drilling and Monitoring Well Installation (including perimeter borings and plant recreation area borings)
 - Hydrogen Cyanide (HCN) and Hydrogen Fluoride (HF):
Upon encountering ground water and suspected fill materials
 - Organic Vapors (OV): Continuously during drilling

- ◆ Waste Potliner Storage Area Borings
 - HCN and HF: Once per boring
 - OV: Continuously during drilling

- ◆ Disposal Pond Sludge Sampling
 - HCN and HF: Upon withdrawal of sampling tools from borehole
 - OV: Continuously, during sampling

◆ Disposal Pond Infiltrometer Testing

- HCN and HF: Prior to testing at each location
- OV: Prior to testing at each location

◆ Ground-Water Sampling

- HCN and HF: Initially, upon opening well cap, once early during evacuation, once during acidification of metals sample
- OV: Initially, upon opening well cap, once early during evacuation

◆ Seep Sampling

- HCN and HF: Immediately prior to sample collection

Personnel, other than the SSO, who will be performing breathing space monitoring will be briefed on the proper use of detector tubes and operation of the organic vapor monitoring device. Operating and sampling procedures will be in accordance with the manufacturer's guidelines.

Initial monitoring for monitoring well and seep sampling activities shall be performed at the point of sample collection for seeps and immediately above the well top, for monitoring

wells. Breathing space monitoring during drilling and sampling shall be performed adjacent to the borehole, but within the actual breathing space of the drilling/ sampling personnel. Monitoring during other activities shall be performed within the actual breathing space of the field personnel.

TABLE 4.7-1

RESPIRATORY PROTECTION ACTION LEVELS

MONITORING PARAMETER	METHOD	MAXIMUM AIRBORNE CONCENTRATION AT LEVEL D (ACTION LEVEL)	RANGE OF DETECTION	MAXIMUM ALLOWABLE CONCENTRATION (MAC)
Organic Vapors	Photoionization Detector/Flame Ionization Detector	10 ppm	0 - 1,000 ppm	400 ppm
Hydrogen Cyanide	Detector Tube	10 ppm*	2.5 - 120 ppm	50 ppm
Hydrogen Fluoride	Detector Tube	3 ppm*	0.5 - 20 ppm	30 ppm

* Based upon the American Conference of Governmental & Industrial Hygienists.

A summary of respiratory action levels is presented on Table 4.7-1. If atmospheric contaminant concentrations approach or exceed the action levels shown in Table 4.7-1, the level of personal protection to be employed during the ongoing work task will be upgraded to full level C, requiring respiratory

protection. Complete removal of cannister-equipped or cartridge-equipped respirators within the work area, where required (full level C), is forbidden. The respiratory protection level may be downgraded when all monitoring parameters remain below their respective action levels in the work area breathing zone for not less than 10 minutes.

Where atmospheric contaminant levels exceed the maximum allowable concentrations (MAC) for level C protection in a level C area, personnel will be evacuated and the SSO notified. If ambient air contaminant concentrations do not drop below the MAC within one-half hour, upgrading of the work area to level B protection will be considered.

4.8 RESPIRATORY PROTECTION PLAN

4.8.1 Employee Protection

Air purifying respirators shall be used, where appropriate, to reduce employee exposure to airborne substances.

The proper type of air-purifying respirator (see Section 4.8.3) shall be provided for all G&M employees at the site. All subcontractors will provide respirators for their own employees from those approved by the National Institute for Occupational Safety and Health.

4.8.2 Visitor Protection

All visitors to the site shall be instructed to stay outside of the exclusion zone(s)/work area(s) and remain within the support zone during the extent of their stay.

Visitors authorized to enter the work area(s) must wear appropriate personal protective gear within the work area(s) as approved by the SSO or his designee. Visitors who wish to enter the work area(s) must produce evidence that they have had a complete physical examination and respiratory protection training within the past twelve months prior to donning respiratory protection and entering the work area(s).

Visitors shall be cautioned to avoid skin contact with contaminated or suspected contaminated surfaces. During visitation, hand-to-mouth transfers should be reduced with special precautions not to eat, drink, smoke or chew gum or tobacco. The use of alcohol or medicine is prohibited.

4.8.3 Respirator Selection, Use, and Maintenance

The following air purifying respirators have been selected for use, when required, during the RI:

- ◆ Full-face air purifying respirator equipped with MSA Type N, model HW cannister, to be used for protection against polynuclear aromatic hydrocarbons, hydrogen fluoride (color coded red with purple stripe around bottom);
- ◆ Full-face air purifying respirator equipped with MSA model GMK cannister, for protection against hydrogen cyanide (color coded white with green stripe around bottom);
- ◆ Half-face air purifying respirator (up to 2 mg/m^3 of polynuclear aromatic hydrocarbons) and full-face air purifying respirator (up to 20 mg/m^3 polynuclear aromatic

hydrocarbons) equipped with organic vapor/highly toxic particulates combination filters (color coded purple over black).

Respirators are to be used only in conjunction with breathing space air monitoring, as outlined in Section 4.7, with strict adherence to the action limits outlined in Table 4.7-1. A respirator may only be used when the device affords protection for the substances being encountered. Respirators have been selected based upon the substances which may be present and the concentrations of these substances previously encountered at the Ormet site. If an air purifying respirator cannot provide protection against all substances present at concentrations exceeding the action level, upgrading of respiratory protection to require a clean breathing air source will be required.

All G&M and subcontractor personnel who will be taking part in the RI will be required to provide evidence at the start of the field program that they have completed the training and health monitoring requirements of OSHA 29 CFR 1910.120. G&M and subcontractor personnel will be briefed on the proper use, maintenance, and limitations of air purifying respirators prior to RI startup. G&M will also provide a qualitative respiratory fit test to assure the proper fit of the device. Results of the

qualitative fit test of field personnel will be recorded by the SSO, along with documentation of the respiratory protection briefing.

Respirators issued to individuals will be cleaned and disinfected at least daily. Where respirators are used by more than one person, the respirator will be cleaned and disinfected after each use. Respirators will be inspected during cleaning, and any necessary repairs will be made at that time. Damaged respirators will not be worn. After cleaning, respirators will be placed in clean, plastic bags and stored in a clean location convenient to the work areas.

The effectiveness of the respiratory protection program will be monitored approximately weekly by the SSO or his designee. Monitoring of worker stress levels during activities which require respiratory protection will also be performed by the SSO or his designee.

Should upgrading to level B (supplied-air systems) be required, all previously described requirements for the use and maintenance of respirators will continue to be enforced. In addition, the requirements for breathing quality air outlined in OSHA 29 CFR 1910.134 will be met.

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In the unlikely occurrence the supplied air systems are required for RI activities, backup personnel equipped with self contained breathing apparatus will also be present, as required by OSHA 29 CFR 1910.134.

4.9 DECONTAMINATION

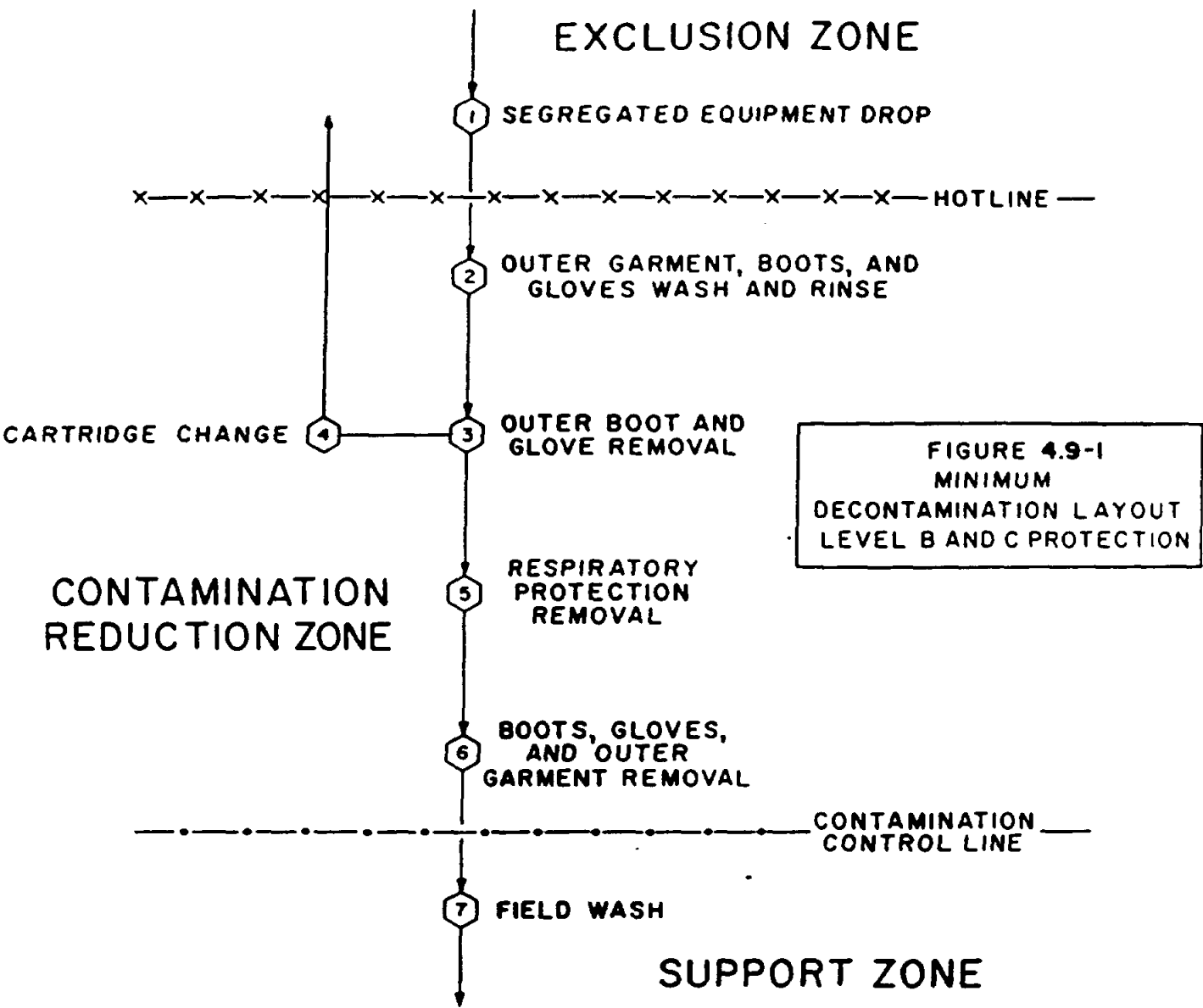
All personnel performing work tasks in the exclusion zone(s) must pass through the CRZ Decontamination Procedure, regardless of the work task or protection level used. All drilling equipment, tools and vehicles used within work areas will likewise undergo decontamination prior to removal from the CRZ. Final inspection of the vehicles and drilling equipment prior to leaving the CRZ is the responsibility of the SSO or his designee.

4.9.1 Personnel

The following representative decontamination procedure will be employed for those work tasks requiring level C protection (see Figure 4.9-1).

♦ Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Tools and devices will be washed/wiped in a detergent solution and rinsed with clean water, then stored or serviced for reuse. Sampling tools



and similar field equipment may require high-temperature water/steam wash. This station may be located adjacent to the CRZ decontamination line.

♦ Station 2: Outer Garment, Boots and Gloves, Wash and Rinse

Scrub outer boots and gloves with decon solution, consisting of detergent and water. Rinse gloves, boots, and garment, with hand-pump spray bottle into plastic bucket or tub.

♦ Station 3: Outer Glove Removal

Remove outer gloves and any accompanying tape. Tape should be placed in a container with a plastic liner. Reusable gloves will be stored for future use.

♦ Station 4: Canister Change

If a worker leaves the exclusion zone to change a respirator canister, this is the last step in the decontamination procedure. Once the worker's canister is exchanged, the outer glove and boot covers are donned and joints taped if required. The worker may then return to the exclusion zone.

♦ Station 5: Respiratory Protection Removal

Remove the respirator face piece, and place respirator in plastic-lined container for decontamination.

♦ Station 6: Boots, Gloves, and Outer Garment Removal

Remove outer garment, boots, and inner gloves, in that order. The outer, disposable, chemically-resistant garment should be deposited in a plastic-lined container. Reusable protective garments will be removed and stored for future use.

Upon removal of inner protective gloves, boots and protective clothing, personnel will pass into the clean portion of the CRZ for washing of hands and face. Respirators will be stored within the clean area after being decontaminated. The procedure for decontamination of personnel wearing level D protection is similar to that for level C, but without stations for respirator removal and storage. Outer boots and coveralls will be stored or discarded and not worn within the support areas.

Shower facilities will be available for personnel at the Ormet Plant. Personnel will pass through the decontamination procedure prior to eating lunch, and when leaving the CRZ.

4.9.2 Equipment and Vehicles

Tools and equipment will be washed with decon solution and rinsed with clean water and, if required, steam cleaned prior to reuse, to the satisfaction of the Site Safety Officer. Drilling rigs and support vehicles leaving the CRZ will, likewise, be decontaminated via steam cleaning to the satisfaction of the Site Safety Officer in a designated steam-cleaning area.

4.9.3 Decontamination Personnel

Personnel working in the CRZ will wear, as a minimum, modified level C protection (no respiratory protection), including splash shield, during decontamination. Decontamination personnel will be required to pass through the decontamination procedure prior to leaving the CRZ.

4.9.4 Decontamination Waste Disposal

Solid wastes will be containerized and disposed of in an approved manner.

4.9.5 Equipment Needs

The following equipment will be used during the decontamination procedure for level C (and level D) protection;

♦ Station 1:

- o Plastic drop cloths
- o Plastic 30- or 50-gallon containers

♦ Station 2:

- o Hand-operated garden-type sprayers (2)
- o Large (30- to 50-gallon) tubs or wash basins
- o Plastic buckets
- o Brushes
- o Decon solution
 - MSA cleaner-sanitizer or Micro laboratory cleaner

♦ Station 3:

- o Plastic liners
- o Plastic containers (30 to 50 gallons)
- o Storage racks for gloves

♦ Station 4:

- Duct tape
- Respirator canisters
- Fully-charged air bottles (if SCBAs are required)

♦ Station 5:

- Plastic liners
- Plastic containers (30 to 50 gallons)
- Boric acid for respirator decontamination

♦ Station 6:

- Plastic liners
- Plastic containers (30 to 50 gallons)
- Bench
- Rack for boots

♦ Other Equipment:

- Hand operated garden-type sprayers for vehicle and equipment washing and rinsing
- Steam Cleaner

- o Potable water supply
- o Wash basins
- o Toilets

4.9.6 Contaminant Containment

A housekeeping program will be implemented during the course of the investigation to avoid the spread of any contaminants beyond the exclusion area(s). The program shall include:

- ♦ Periodic policing of the work areas for debris, including paper products, cans, etc.;
- ♦ Periodic changing of wash and rinse water for hand, face, and equipment; and
- ♦ Periodic removal (weekly minimum) of all garbage bags and containers used to dispose of disposable clothing. Contaminated materials will be disposed of in an approved manner.

In addition to the aforementioned measures, drill cuttings, waste, and well-development water generated along or within disposal ponds and waste potliner storage area will be disposed

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of within the ponds or storage area. Soils generated during drilling outside of visually defined exclusion zones/work areas will be removed, to prevent exposure to the environment. Loose soil material will be removed from drilling rigs and vehicles prior to any travel and the contaminated material will be properly disposed of.

4.10 HEALTH MONITORING PROGRAM

4.10.1 Medical Surveillance

All G&M employees participate in a comprehensive health-monitoring program. Each employee is given an annual medical examination. Dependent on specific work assignments, semiannual and specific biological and/or chemical monitoring may also be required.

The basic medical examination consists on the following:

- . Personal, family, and environmental history
- . Hands-on physical examination
- . Snellen's eye examination
- . Pap smear (females over age 21)
- . Hemoccult testing (over age 40)
- . Laboratory testing:

A. Complete Blood Count:

- . Red blood count
- . White blood count
- . Differential screening

- Hemoglobin
- Hematocrit

B. Urinalysis:

- Sugar
- Albumin
- Specific Gravity
- Microscopic

C. Laboratory Chemistries:

- A/G Ratio
- Albumin
- Alkaline Phosphatase
- Bilirubin, Total
- Calcium
- Chloride
- Cholesterol
- Creatinine
- GGT
- Globulins
- Glucose
- Iron
- Lactic Dehydrogenase (LDH)

- Phosphorus
- Potassium
- Protein, Total
- SGOT
- SGPT
- Sodium
- Triglycerides
- Urea Nitrogen (BUN)
- Uric Acid
- Serum PCBs

The results of the examinations are reviewed by physicians who specialize in occupational health. A letter summarizing the physician's opinion regarding the employee's health is issued; this letter includes the physician's opinion as to whether or not the employee should be precluded from wearing respiratory protection as required by OSHA 1910.134 and 1910.1001-1046. Results of the physicals and physicians' written recommendations are on file with the G&M Health and Safety Manager.

Subcontractor physical examinations will be the responsibility of the drilling contractor. Employee physicals will be performed at a hospital providing, at a minimum, the previously outlined health-screening parameters. Dependent upon operational employee exposures during project work, additional monitoring may be required.

4.10.2 Employee Stress Monitoring

Monitoring of employees for heat and cold-related stresses will be conducted during all breaks and lunch periods, or as considered necessary by the Site Safety Officer based on weather and working conditions. Monitoring of field personnel for the following list of symptoms/effects will be carried out as described above, and additional rest or warm-up periods will be permitted, if necessary, to protect the worker's health.

4.10.3 Heat-Related Problems

- ♦ Heat Rash - Caused by continuous exposure to heat and humid air and aggravated by chafing clothes and protective clothing. Decreases ability to tolerate heat, as well as being a nuisance.

- ♦ Heat Cramps - Caused by profuse perspiration with inadequate fluid intake and chemical replacement (especially salts). Signs: muscle spasm and pain in the extremities and abdomen.

- ♦ Heat Exhaustion - Caused by increased stress on various organs to meet increased demands to cool the body. Signs: shallow breathing; pale, cool, moist skin; profuse sweating; dizziness and lassitude.

- ♦ **Heat Stroke** - The most severe form of heat stress. Body must be cooled immediately to prevent severe injury and/or death. Signs: red or flushed skin; hot, dry skin, and extremely high body temperature. Requires immediate trained medical attention.

4.10.4 Heat Stress Reduction Methods

- ♦ Acclimatize field personnel to heat exposure through gradual increase to full anticipated workload across several days.
- ♦ Drink more fluids providing the proper balance of water and salts.
- ♦ Rest frequently.
- ♦ Wear cotton clothing under protective garment.

4.10.5 Effects of Low Temperature Exposure

- ♦ **Frostbite** - Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body which have high surface-area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible.

- ♦ **Hypothermia** - Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

- o Shivering;
- o Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F;
- o Unconsciousness, glassy stare, slow pulse, and slow respiratory rate;
- o Freezing of the extremities; and
- o Death.

4.10.6 Avoidance Measures

To prevent cold-related injuries, personnel working in the cold should wear adequate clothing and reduce the time spent in the cold area.

4.10.7 Rest Periods

A 15-minute rest period will be taken by personnel in the morning and afternoon along with a 30-minute lunch period. Breaks and lunch periods will be taken within the support zone, after decontamination. Additional breaks will be allotted based upon weather conditions and the amount of strenuous efforts required for some tasks.

4.11 COMMUNICATIONS

Communication between work areas and the command post, located within the support zone, will be via verbal communication, compressed air horn or walkie-talkie. A telephone will be located near the command post, which shall be used to communicate with Ormet security personnel and outside emergency and medical facilities.

The following signals shall be established for use with compressed-air type horns:

- ♦ 1 long blast (2 second duration): Evacuate exclusion area, meet at CRZ or designated area;
- ♦ 1 long blast, 2 short blasts: Prepare for removal of injured personnel, evacuate work area;
- ♦ 3 short blasts: All clear;
- ♦ 4 short blasts: End of day, prepare for decontamination.

4.12 ON-SITE EMERGENCY PLAN

A step-wise approach for dealing with emergency situations has been developed to address the immediate needs of on-site emergency activities (Figures 4.12-2 and 4.12-3). The plan describes the action that shall be implemented in the event of an emergency and includes a list of Emergency Information Telephone Numbers to assist during the event.

Based upon the extensive ground-water quality data and data from analyses of disposal pond solids and former potliner storage area soils collected during previous G&M investigations, the potential for release of more than trace concentrations of hydrogen cyanide and particularly hydrogen fluoride during the RI is very remote. Situations which may require emergency response are more likely to result from physical accidents and injury or improper handling of fuels. No handling of flammable substances other than gasoline or diesel fuel is anticipated during the RI.

4.12.1 Medical Emergencies

In the event of any injury or chemical exposure requiring movement of the patient to the hospital by ambulance, the SSO or his designee will contact the hospital (Wetzel County Hospital) and the ambulance service (Clarrington Emergency Squad) while the victim is removed from the exclusion zone and through decontamination for pickup by the ambulance. The hospital is

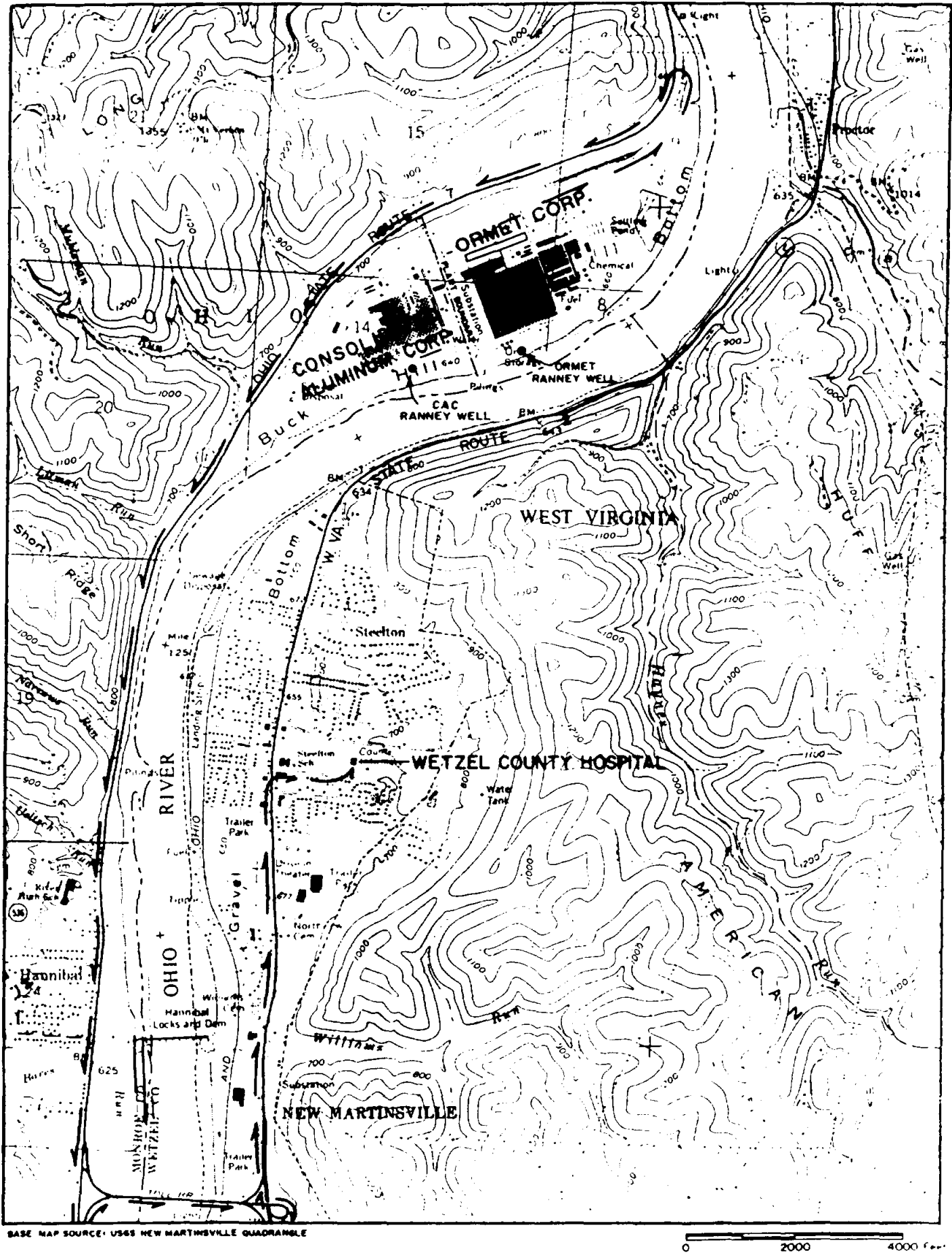


FIGURE 4.12-1 Route to Wetzel County Hospital

Ormet Corporation

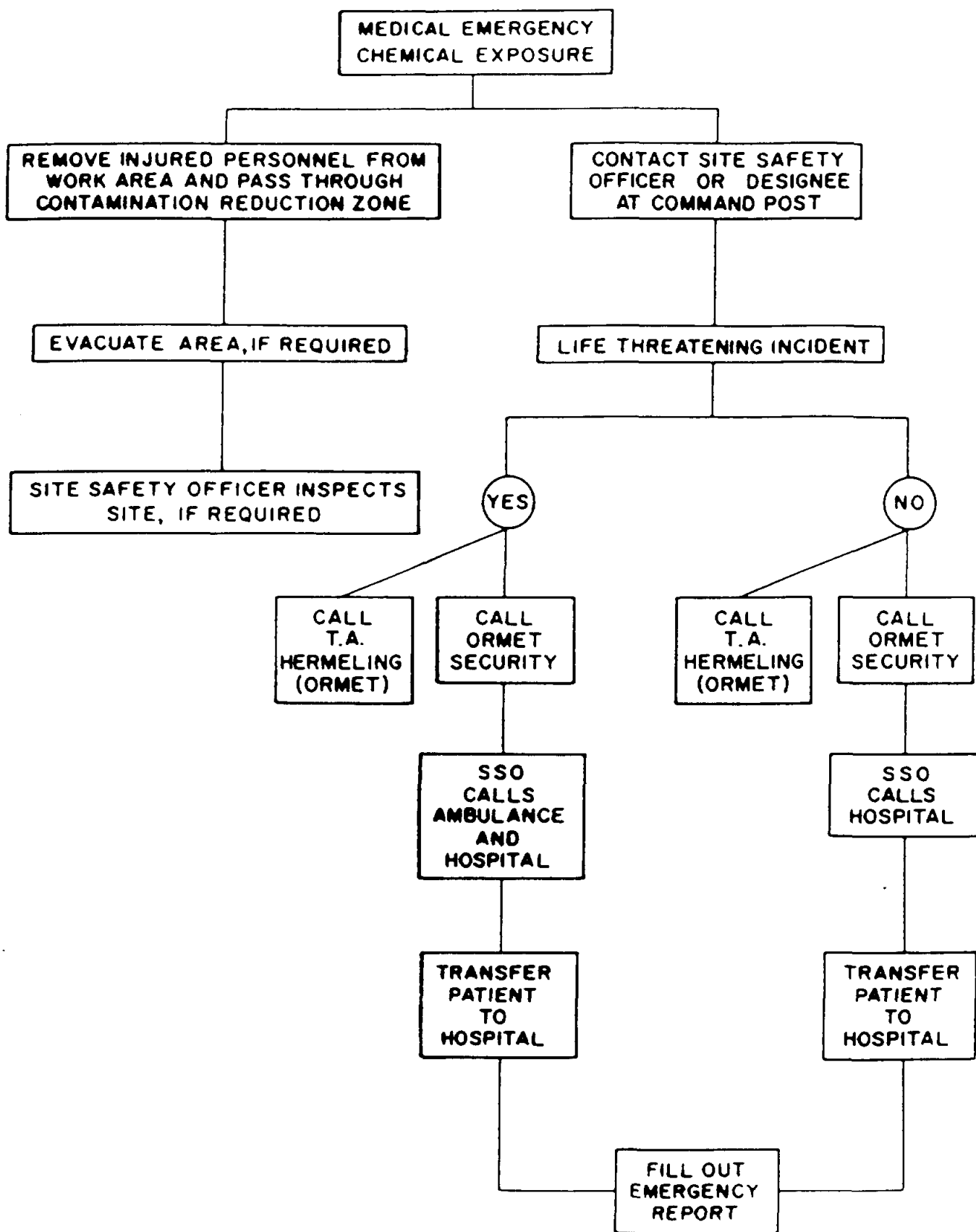


FIGURE 4.12-2 Emergency Response Flow Chart for Medical Emergency

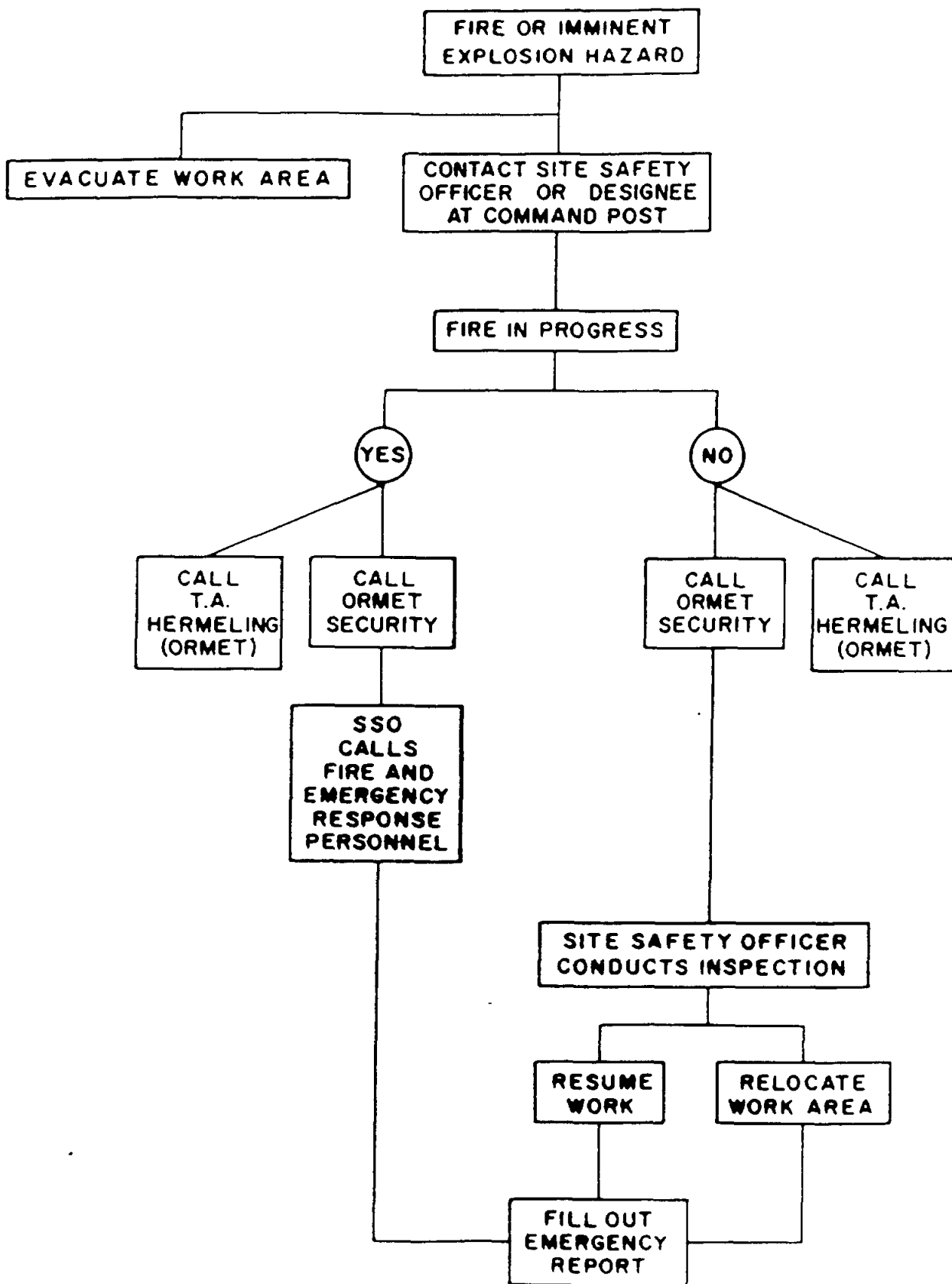


FIGURE 4.12-3 Emergency Response Flow Chart for Fire and/or Explosive Hazard.

located in New Martinsville, West Virginia, 8.5 miles from the site (see Figure 4.12-1). A map showing the route to the hospital and a list of emergency telephone numbers will be conspicuously posted at the command post.

In the event of chemical exposure requiring emergency treatment, all personnel within the affected work area will be evacuated, along with removal of the victim, until an investigation by the SSO is conducted and the area declared safe for work to continue. Personnel will assemble at the CRZ upon evacuation. An emergency report must be completed by the SSO for each instance of employee injury or possible exposure (see Figure 4.12-4).

G&M personnel who will be performing the RI field activities will receive a briefing in the identification and preliminary treatment of cyanide poisoning, which will be provided by a qualified medical professional. Materials for the preliminary treatment of cyanide poisoning (amyl nitrite ampules) will be kept on-site, along with written procedures for the treatment of cyanide poisoning.

In addition to the amyl nitrite ampules, a first aid kit for use on minor cuts, abrasions, etc. will be kept at the command post. Portable emergency eyewash stations will be kept at active work area and will be readily accessible (within 10 seconds) to RI personnel.

A representative of the Wetzel County Hospital will be contacted prior to startup of the field program regarding the proposed scope of work, the types of potential injuries which may be experienced by field personnel, potential exposure hazards which may be encountered, and other pertinent safety and treatment-related information.

4.12.2 Fire or Atmospheric-Related Release

In the event of fire or atmospheric release requiring the evacuation of more than an individual work area, the evacuation signal will be given (via compressed air horn - see Section 4.11) and all site personnel will assemble at the CRZ or other agreed upon location. The SSO or his designee will contact and inform Ormet security of the nature and extent of the emergency. Dependent upon the type and magnitude of the emergency, the appropriate emergency response organization will be notified by the SSO or Ormet Security, these include:

- ♦ Ormet fire brigade;
- ♦ Northern Ohio River Mutual Aid Council (NORIMAC);
- ♦ Clarington, Ohio Volunteer Fire Department/Emergency Squad;
- ♦ Ohio EPA Emergency Response Group
- ♦ U.S. EPA Region V Eastern Reponse Unit

FIGURE 4.12-4
EMERGENCY REPORT

1. Date: _____
2. Time of Accident: _____
Climatic Conditions: _____
3. On-Site Coordinator: _____
4. Employee Injured: _____
5. Company Affiliation: _____
6. Social Security Number: _____
7. Insurance Company: _____
8. Number of Workers at Site: _____
Name of Workers: _____ Company Affiliation: _____
 1. _____
 2. _____
 3. _____
 4. _____
 5. _____
9. Circumstances of the Injury/Emergency Action: _____

10. Emergency Actions Taken: _____

11. What first aid was provided? _____
12. Was an emergency phone call made to the Project Safety Officer? _____ If so, time: _____
13. Ambulance Service Used: _____
14. Hospital Used: _____
15. Attending Physician: _____
16. Company Representatives Contacted: _____
17. Contractor Representatives Contacted: _____

ATTACHMENT 4-B

CHEMICAL HAZARD SUPPORT DATA

Conversion to local identifiers resulted in 1 unique occurrences.

Conversion Entry 1; Accession No. 9200126

(CAS) CAS Registry Number: 83-32-9

(SIC) SIC Code: 2821; 2865; 2879

(MAT) Material Name: \$\$\$ ACENAPHTHENE \$\$\$

(FML) Chemical Formula: C12H10

(USS) Common Uses: DYE INTERMEDIATE; MANUFACTURE OF SOME PLASTICS; AS AN INSECTICIDE AND FUNGICIDE (AWQCD* 0001)

(CON) Containers: FIBER DRUMS (CCDCDS 0002)

(BIN) Binary Reactants: OZONE AND CHLORINATING AGENTS OXIDIZE POLYCYCLIC AROMATIC HYDROCARBONS TO QUINONES, DIACIDS, AND NUCLEAR AND SIDE-CHAIN OXIDATION PRODUCTS. CHLORINATING AGENTS ALSO PRODUCE CHLORINE-SUBSTITUTED DERIVATIVES. (HBKEC* 0001) (PPOM** 0001) REACTIONS OF PAH WITH ORGANIC AND INORGANIC OXIDANTS INCLUDING VARIOUS ELECTROPHILES, PEROXIDES, NITROGEN OXIDES, AND SULFUR OXIDES WERE REVIEWED BY THE NATIONAL ACADEMY OF SCIENCES IN RELATION TO OXIDATION OF ATMOSPHERIC PAH IN (PPOM** 0001). THE MOST COMMON PHOTOOXIDATION PRODUCT IN SOLUTION IS AN ENDO PEROXIDE. DEALKYLATION, RING CLEAVAGE, AND OTHER REACTIONS ENSUE FOLLOWING PHOTOLYSIS OR PYROLYSIS OF THESE PEROXIDES. FREQUENTLY, ONLY QUINONES ARE ISOLABLE. PHOTODIMERS MAY RESULT IN SOME CASES. ADSORBED PAH ARE MORE REACTIVE THAN IN SOLUTION. (PPOM** 0001)

(LOL) Detection Limit (Lab; Techniques,Ref) (ppm): IN WASTEWATER, EXTRACTION, THEN HPLC/UV, 3E-3 DETECTION LIMIT, OPTIONAL CLEANUP, PRIORITY POLLUTANT METHOD 610 (FEREAC 0010); IN WASTEWATER, EXTRACTION, THEN HPLC/FLUORESCENCE, OPTIONAL CLEANUP, PRIORITY POLLUTANT METHOD 610, (FEREAC 0010); IN WASTEWATER, EXTRACTION THEN GC/FID, OPTIONAL CLEANUP, PRIORITY POLLUTANT METHOD 610 (FEREAC 0010); IN WASTEWATER, EXTRACTION, THEN GC/MS, 1E-3 DETECTION LIMIT, PRIORITY POLLUTANT METHOD 625 (FEREAC 0014); IN WATER, COLLECT ON FOAM PLUG, ELUTE, PARTITION, COLUMN CHROMATOGRAPHY, THEN TLC-FLUORESCENCE AND GC/FID, 60 LITERS COLLECTED, NOT VALIDATED FOR THIS COMPOUND (ME022* 0001); ANY MATRIX, EXTRACT INTO METHYLENE CHLORIDE, SPOT ON PAPER, SENSITIZE, OBSERVE AT 254 NM, 1E-5 DETECTION LIMIT, DETECTION LIMIT VARIES FROM COMPOUND TO COMPOUND, NOT SPECIFIC FOR INDIVIDUAL COMPOUNDS (ME023* 0001)

(STD) Standard Codes: SUPERFUND DESIGNATED (HAZARDOUS SUBSTANCES) LIST

(MLT) Melting Point (C.): 95 (PURE); 90 TO 95 (TECHNICAL); 95 TO 97 (TECHNICAL)

(BLP) Boiling Point (C.): 279

(SOL) Solubility (ppm @ 25C): 1.84 (SEAWATER); 2.42 (DISTILLED WATER) (ESTHAG 0021); 3.42 (USPEDU 0001)

(SPG) Specific Gravity: 1.189 (MEIEDD 0001); 1.069 (TECHNICAL GRADE) (ALFA** 0001); 1.024 (99/4) (DPMADX 0001)

(VPN) Vapor Pressure (mm Hg): 0.001 TO 0.01; <0.02; 10

(VDN) Vapor Density: 5.32 (DPMADX 0001)

(PER) Persistency: AIRBORNE PARTICULATE POLYCYCLIC AROMATIC HYDROCARBONS CAN PERSIST AT RELATIVELY HIGH CONCENTRATIONS IN AEROSOLS TRANSPORTED FOR LONG DISTANCES. THE ATMOSPHERIC PERSISTENCE IS LONGER THAN WOULD BE PREDICTED FROM LABORATORY PHOTOOXIDATION STUDIES. (PAHAE* 79/NEF) ON THE OTHER HAND, THE

ANTHRACENE

ATH

Common Synonyms Anthracen Paranaphthalene Green oil		Solid	White to yellow	Weak aromatic odor
Sinks in water.				
Stop discharge if possible. Keep people away Avoid contact with solid and dust Isolate and remove discharged material. Notify local health and pollution control agencies				
Fire		Combustible. Dust cloud may explode if ignited in an enclosed area. Extinguish with water, dry chemicals, foam, or carbon dioxide.		
Exposure		CALL FOR MEDICAL AID DUST Irritating to eyes, nose and throat. If inhaled will cause coughing or difficult breathing. If in eyes, hold eyelids open and flush with plenty of water If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Water Pollution		Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Harm 2.2 Class: Not pertinent		
3. CHEMICAL DESIGNATIONS 3.1 OS Compatibility Class: Not listed 3.2 Formula: C ₁₄ H ₁₀ 3.3 ISO/UN Designation: Not listed 3.4 DOT ID No.: Data not available 3.5 CAS Registry No.: 130-12-7		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White to yellow 4.3 Odor: Weak aromatic		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Dust mask; goggles or face shield; rubber gloves 5.2 Symptoms Following Exposure: Inhalation of dust irritates nose and throat. Contact with eyes causes irritation. 5.3 Treatment of Exposure: INHALATION: move to fresh air. EYES: flush with water for 15 min. 5.4 Threshold Limit Value: Data not available 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Data not available 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLN Value: Data not available				

6. FIRE HAZARDS 6.1 Flash Point: 250°F 6.2 Flammable Limits in Air: 0.6% LEL 6.3 Fire Extinguishing Agents: Water, foam, dry chemical, carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Data not available 6.5 Special Hazards of Combustion Products: Data not available 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: 1004°F 6.8 Self-Heating Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Static-Sensitive Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: Data not available 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Bases: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Water Ratio (Resistant to Products): Data not available 7.8 Reactivity Groups: Data not available	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Not listed 11.2 NFPA Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classifications: Category Classification Health Hazard (Blue) 0 Flammability (Red) 1 Reactivity (Yellow) -
8. WATER POLLUTION 8.1 Aquatic Toxicity: 5 ppm/24 hr/fresh & brackish/no effect 8.2 Waterfowl Toxicity: Data not available 8.3 Stages of Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 178.23 12.3 Boiling Point at 1 atm: 340.2°F = 341.2°C = 614.4°K 12.4 Freezing Point: 421.7°F = 216.5°C = 489.7°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.24 at 20°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Intermittent Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Heat): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: -17,100 Btu/lb = -4,910 cal/g = -205 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.18 Heat of Fusion: 38.70 cal/g 12.19 Limiting Value: Data not available 12.20 Solid Vapor Pressure: Data not available
9. SHIPPING INFORMATION 9.1 Grades of Purity: Various fluorescence grades; Scintillation grade; Technical grade, 90-99% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open	NOTES

HALF-LIFE OF PAH'S IN POLLUTED ATMOSPHERES MAY BE LIMITED TO HOURS OR DAYS IN STRONG SUNLIGHT. (PPOM** 0001) PAH DEPOSITED IN SEDIMENTS ARE LESS SUBJECT TO PHOTOCHEMICAL OR BIOLOGICAL OXIDATION, ESPECIALLY IF THE SEDIMENT IS ANOXIC. SEDIMENTARY PAH IS THEREFORE QUITE PERSISTENT AND MAY ACCUMULATE TO HIGH CONCENTRATIONS (PAHAE* 79/NEF) ACENAPHTHENE RESISTS PHOTOCHEMICAL DEGRADATION IN SOIL (AWQCD* 0001)

- (PFA) Potential for Accumulation: IN GENERAL, POLYCYCLIC AROMATIC HYDROCARBONS WITH FEWER THAN FOUR RINGS ARE READILY METABOLIZED. LONG-TERM PARTITIONING INTO BIOTA IS NOT A SIGNIFICANT FATE PROCESS. THE LOG OCTANOL/WATER PARTITION COEFFICIENT OF ACENAPHTHENE IS 4.33 CALCULATED AS PER LEO ET AL, 1971 CITED IN (USPEDU 0001) BLUEGILL ACCUMULATED ACENAPHTHENE OVER A 28-DAY EXPOSURE WITH A BIOCONCENTRATION FACTOR OF 387. THE HALF-LIFE IN THE WHOLE BODY WAS LESS THAN 1 DAY. THE WEIGHTED AVERAGE BIOCONCENTRATION FACTOR (BCF) FOR ACENAPHTHENE--WHICH ADJUSTS THE BCF FROM THE 4.8 PERCENT LIPID OF THE BLUEGILL TO THE 3.0 PERCENT LIPIDS THAT IS THE WEIGHTED AVERAGE FOR CONSUMED FRESHWATER AND ESTUARINE FISH AND SHELLFISH--IS 242. (AWQCD* 0001) IN MOST CASES, PAH'S ARE LESS BIOAVAILABLE WHEN COMPLEXED TO COLLOIDAL ORGANIC MATERIALS OR ADSORBED TO ORGANIC OR INORGANIC PARTICULATES THAN WHEN IN SOLUTION OR IN FINE DISPERSION IN WATER. (PAHAE* 79/NEF)
- (CAG) Carcinogenicity: NEUKOMM, 1974, CITED IN (AWQCD* 0001) REPORTED NEGATIVE RESULTS FOR ACENAPHTHENE IN A PREDICTIVE TEST FOR CARCINOGENICITY BASED ON NEOPLASTIC INDUCTION IN THE NEWT TRITURUS CRISTATUS.
- (MUT) Mutagenicity: SEVERAL MUTAGENICITY TESTS REVIEWED IN (AWQCD* 0001) WERE NEGATIVE OR INCONCLUSIVE. HOWEVER, ACENAPHTHENE--VAPOR, SOLID, OR SATURATED SOLUTION--PRODUCES POLYPLOID AND OTHER MITOTIC EFFECTS IN MICROORGANISMS AND PLANTS.
- (TER) Teratogenicity: NO DATA AVAILABLE (AWQCD* 0001)
- (TRT) Major Species Threatened: IN MOST CASES, CRUSTACEANS ARE THE MOST SENSITIVE AQUATIC ORGANISMS TO POLYCYCLIC AROMATIC HYDROCARBONS. FISH ARE THE MOST RESISTANT. POLYCHAETE WORMS SHOW INTERMEDIATE SENSITIVITY. ACENAPHTHENE IS ONLY SLIGHTLY TOXIC OR PRACTICALLY NONTOXIC TO MAMMALS.
- (INT) Inhalation Limit (Text): THERE ARE NO THRESHOLD LIMIT VALUES FOR SPECIFIC POLYCYCLIC AROMATIC HYDROCARBONS. OSHA PEL (TWA) FOR COAL TAR VOLATILES (BENZENE-SOLUBLE FRACTION) ANTHRACENE, BAP, PHENANTHRENE, ACRIDINE, CHRYSENE, PYRENE IS 0.2 MG/M3. OSHA CATEGORIZES PARTICULATE PAH'S AS HUMAN CARCINOGENS AND ESTABLISHED AN 8-HOUR TIME-WEIGHTED AVERAGE OF 150 .MU.6/M3 FOR COKE OVEN EMISSIONS. (29CFR* 1910) NIOSH RECOMMENDED A 10-HOUR TIME-WEIGHTED AVERAGE OF 0.1 MG/M3 FOR COAL TAR PRODUCTS SUCH AS COAL TAR, CREOSOTE, AND COAL TAR PITCH. (CRSOE* 78-107,77/NIOSH) THE AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS, ACGIH, RECOMMENDED AN 8-HOUR TIME-WEIGHTED AVERAGE OF 0.2 MG/M3 FOR THE BENZENE-SOLUBLE FRACTION OF COAL TAR PITCH OR VOLATILES. (TLVADM 83/ACGIH) UPDATED 3/84
- (DRC) Direct Contact: IRRITATING TO SKIN AND MUCOUS MEMBRANES. (DPMADX 0001)
- (JNS) General Sensation: IRRITANT. MAY CAUSE VOMITING IF LARGE AMOUNTS ARE INGESTED. (DPMADX 0001)
- (LOT) Odor Threshold, Lower (ppm): 0.02
- (MOT) Odor Threshold, Medium (ppm): 0.08
- (UOT) Odor Threshold, Upper (ppm): 0.22
- (AHL) Acute Hazard Level: POLYCYCLIC AROMATIC HYDROCARBONS CAN PRESUMABLY BE ABSORBED FROM INGESTION, INHALATION, AND SKIN

rtacs

RTECS Search System (Version 6.5/14.2 January 1986) (\$55/hr)

Toxicity data in RTECS have not been critically evaluated

Latest news for RTECS . . .

21 May 86; Correction Made to Database

Option? type 2/msds.rtacs

Entry 1 CAS RN 117-81-7 NIOSH number TI0350000

MAT: PHTHALIC ACID, BIS(2-ETHYLHEXYL) ESTER

FML: C24-H38-O4

TOXICITY DATA:

orl-man TDLo:143 mg/kg
orl-rat LD50:31 gm/kg
ipr-rat LD50:30700 mg/kg
ivn-rat LD50:250 mg/kg
orl-mus LD50:30 gm/kg
ipr-mus LD50:14 gm/kg
ivn-mus LD50:1060 mg/kg
orl-rbt LD50:34 gm/kg
skn-rbt LD50:25 gm/kg
orl-gpg LD50:26 gm/kg
skn-gpg LD50:10 gm/kg
ihl-mam LC50:30000 mg/m3

DATA REFERENCES:

CLASS: AGRICULTURAL CHEMICAL

CLASS: TUMORIGEN

CLASS: MUTAGEN

CLASS: TERATOGEN

CLASS: SKIN AND EYE IRRITANT

IARCP: CARCINOGENIC REVIEW:ANIMAL POSITIVE

IARCN: CARCINOGENIC REVIEW:HUMAN INDEFINITE

OCCER: TLV-TWA 5 mg/m3; STEL 10 mg/m3

OSHA: OSHA STANDARD-air:TWA 5 mg/m3 (SCP-D)

OSHA: MSHA STANDARD-air:TWA 5 mg/m3

OCCER: OCCUPATIONAL EXPOSURE TO DEHP recm

std-air:Reduce to lowest feasible

level

NCIP: NTP CARCINOGENESIS BIOASSAY COMPLETED;RESULTS
POSITIVE:MOUSE, RAT

NTPT: NTP CARCINOGENESIS STUDIES; SELECTED, NOVEMBER 1985

NTPT: NTP FOURTH ANNUAL REPORT ON CARCINOGENS, 1984

NIOSH: "NIOSH MANUAL OF ANALYTICAL METHODS" VOL 2 S40
NIMAM*

NIOSH: "NIOSH MANUAL OF ANALYTICAL METHODS" TO BE REVISED BY JUNE, 1985

FRAME REPORTED IN EPA TOXIC INVENTORY 1987

- (CHL) Chronic Hazard Level: SLIGHT INGESTIVE AND INHALATIVE TOXIN WITH CHRONIC EXPOSURE. CHRONIC EXPOSURE OF AQUATIC INSECTS TO .003 PPM LED TO DECREASES IN, PRODUCTIVITY. (ENVRAL 0001) SIGNIFICANT INCREASE IN LIVER SIZE MAY OCCUR. (TXAPA9 0045); INGESTION OF .4 G/KG/DAY CAN CAUSE RETARDATION IN RAT GROWTH. DEHP APPEARS TO HAVE AN ACCUMULATIVE EFFECT. (R57*** 0001); FRESHWATER SHOULD NOT EXCEED .3 PPB; PHTHALATE ESTERS (R184** 0001).
- (HEL) Degree of Hazard to Public Health: SLIGHT INHALATIVE AND INGESTIVE TOXIN.
- (AIR) Air Pollution: NONE.
- (ACT) Action Levels: REMOVE IGNITION SOURCE. ATTEMPT TO CONTAIN SLICK.
- (AML) In Situ Amelioration: OIL SKIMMING EQUIPMENT AND SORBENT FOAMS CAN BE APPLIED TO SLICK. SEEK PROFESSIONAL ENVIRONMENTAL ENGINEERING ASSISTANCE THROUGH EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NO. 201-321-6660.
- (SHR) Beach/Shore Restoration: BURN OFF
- (AVL) Avail. of Countermeasure Material: OIL SKIMMING EQUIPMENT - STORED AT MAJOR PORTS; SORBENT FOAMS (POLYURETHANE) - UPHOLSTERY SHOPS.
- (DIS) Disposal Method: SPRAY INTO INCINERATOR OR BURN IN PAPER PACKAGING. ADDITIONAL FLAMMABLE SOLVENT MAY BE ADDED.
- (IFP) Industrial Fouling Pot.: SLICKS MAY REDUCE HEAT TRANSFER OR CAUSE HOT SPOTS AND SCALING.
- (WAT) Major Water Use Threatened: RECREATION, INDUSTRIAL
- (LOC) Probable Location and State of Material: LIGHT COLORED LIQUID. WILL FLOAT IN SLICK.
- (HOH) Water Chemistry: PHTHALATE ESTERS ARE READILY SEQUESTERED BY OR ABSORBED BY ORGANIC RESIDUES AND SOLID SURFACES IN ENVIRONMENTAL WATER SYSTEMS. ACCUMULATION AND SUBSEQUENT LONG TERM LOW LEVEL RELEASE ARE THEORIZED. (R57*** 0001)
- (DAT) Adequacy of Data: FAIR

Conversion Entry 2; Accession No. 8300217

- (CAS) CAS Registry Number: 117-84-0
- (MAT) Material Name: \$\$\$ DI-N'-OCTYL PHTHALATE \$\$\$
- (FML) Chemical Formula: C24H38O4
- (USS) Common Uses: USED IN LACQUERS FOR INDUSTRIAL FLOORING AND FOR APPLYING PHOSPHOR TO FLUORESCENT LAMPS. (PAE*** 0001) PHTHALATES BASED ON LINEAR C6-C11 ALCOHOLS ARE USED WIDELY AS PLASTICIZERS IN POLY(VINYL CHLORIDE) RESINS FOR AUTOMOTIVE APPLICATIONS. TO A LESSER EXTENT, THEY ARE USED IN PLASTISOLS AND DISPERSION COATINGS AND IN OTHER FILM, SHEETING, COATED FABRIC, AND EXTRUSION APPLICATIONS. (IDCCT* 0001)
- (CON) Containers: PRACTICAL GRADE DNOP (ARISTO LABORATORIES) IS PACKAGED AND SHIPPED IN 5-GALLON PAILS OR 11-POUND BATCHES OR CONTAINERS. (CHMCY* 0001)
- (LDL) Detection Limit (Lab; Techniques,Ref) (ppm): MODERN METHODS OF ANALYSIS OF PHTHALATE ESTERS WERE REVIEWED IN (PEIAE* 0001). DNOP HAS BEEN DETERMINED BY GC AND ELECTRON CAPTURE DETECTION AND BY GC/MA WITH SELECTIVE-ION MONITORING. METHYLENE CHLORIDE EXTRACTION, THEN GC/EC OR GC/FID, IS THE EPA APPROVED METHOD FOR PHTHALATE ESTERS. IN MUNICIPAL AND INDUSTRIAL WASTEWATERS, EXTRACT WITH METHYLENE CHLORIDE, DRY, CONCENTRATE, AND EXCHANGE TO HEXANE. OPTIONAL FLORISIL COLUMN CLEANUP. EPA METHOD 606 (RW031* 0001) (FEREAC 0024)--GC/EC. DETECTION LIMIT 0.003 PPM. EPA METHOD 625 (RW031* 0001) (FEREAC 0014)--GC/MS. DETECTION LIMIT 0.005 PPM. OTHER LONG TERM TESTS

Conversion to local identifiers resulted in 1 unique occurrences.

Conversion Entry 1; Accession No. 7216617

(CAS) CAS Registry Number: 85-68-7
(SIC) SIC Code: 3292; 2821
(MAT) Material Name: BUTYL BENZYL PHTHALATE
(FML) Chemical Formula: C4H9C00C6H4-C00CH2C6H5
(USS) Common Uses: PLASTICIZER FOR POLYVINYL AND CELLULOSIC RESINS;
ORGANIC INTERMEDIATE.
(CON) Containers: 5 AND 55 GALLON DRUMS, TANK CARS.
(STD) Standard Codes: NFPA - 1,1,0; ICC, USCG - NO.
(FLM) Flammability: SLIGHT WHEN EXPOSED TO HEAT OR FLAME.
(TCP) Toxic Combustion Prod.: SLIGHT HAZARD, WEAR CANISTER MASK.
(EXT) Extinguishing Method: WATER OR FOAM MAY CAUSE FROTHING. CARBON
DIOXIDE, DRY CHEMICAL, CARBON TETRACHLORIDE
(FLP) Flash Point (C.): 199
(AIP) Auto Ignition Point(C.): 233
(EXP) Explosiveness: CAN REACT WITH OXIDIZING MATERIALS. REACTIVE ONLY
UNDER EXTREME CONDITIONS.
(MLT) Melting Point (C.): -35
(BLP) Boiling Point (C.): 370
(SOL) Solubility (ppm @ 25C): 3
(SPG) Specific Gravity: 1.1
(VPN) Vapor Pressure (mm Hg): .16
(VDN) Vapor Density: 10.8
(TRT) Major Species Threatened: MAY SMOTHER BENTHIC LIFE
(DRC) Direct Contact: SLIGHTLY TOXIC SKIN, MILD IRRITANT WITH
INTRADERMAL INJECTION.
(JNS) General Sensation: SLIGHT CHARACTERISTIC ODOR. OVER EXPOSURE
IMPOSSIBLE AT AMBIENT TEMPERATURES (R14*** 0001).
(SAF) Personal Safety Precautions: WEAR FULL PROTECTIVE CLOTHING AND
CANISTER MASKS.
(AHL) Acute Hazard Level: UNKNOWN TOXICITY. MAY SMOTHER BENTHIC LIFE.
(CHL) Chronic Hazard Level: UNKNOWN
(HEL) Degree of Hazard to Public Health: UNKNOWN TOXICITY MAY PRODUCE
IRRITATING VAPORS AT ELEVATED TEMPERATURES (R14*** 0001).
(AIR) Air Pollution: LOW
(ACT) Action Levels: APPROACH FROM UPWIND SIDE
(AML) In Situ Amelioration: PUMP OR VACUUM OFF OF BOTTOM. SEEK
PROFESSIONAL ENVIRONMENTAL ENGINEERING ASSISTANCE THROUGH EPA'S
ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NO. 201-
321-6660.
(SHR) Beach/Shore Restoration: BURN OFF UNDER CONTROLLED CONDITIONS
(AVL) Aval. of Countermeasure Material: PUMPS - FIRE DEPARTMENT;
VACUUM - SWIMMING POOL SUPPLIERS.
(DIS) Disposal Method: SPRAY INTO INCINERATOR
(IFP) Industrial Fouling Pot.: MAY CAUSE POOR HEAT TRANSFER, HOT SPOTS
OR SCALING.
(WAT) Major Water Use Threatened: INDUSTRIAL
(LOC) Probable Location and State of Material: CLEAR OILY LIQUID. WILL
SINK TO BOTTOM OF WATER COURSES.
(COL) Color in Water: COLORLESS
(DAT) Adequacy of Data: POOR

Common Synonyms Creosote oil Dead oil	Liquid Yellow to black Tarry odor May float or sink in water.		
Stop discharge if possible. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Combustible. Extinguish with dry chemicals, foam or carbon dioxide. Water may be ineffective on fire.		
Exposure	CALL FOR MEDICAL AID. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk, and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Water Pollution	Effect of low concentrations on aquatic life is unknown. Fouling to shrimps. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
<table><tr><td>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Isolate starting-water contaminant Mechanical containment Should be removed Chemical and physical treatment</td><td>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</td></tr></table>		1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Isolate starting-water contaminant Mechanical containment Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: None 2.2 Class: Not pertinent
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5. HEALTH HAZARDS 5.1 Personal Protective Equipment: AS-servise container mask; rubber gloves; chemical safety goggles and/or face shield; overalls or a respirator apron; barrier creams. 5.2 Symptoms Following Exposure: Vapors cause moderate irritation of nose and throat. Liquid causes severe burns of eyes and reddening and itching of skin. Prolonged contact with skin can cause burns. Ingestion causes irritation, vomiting, respiratory difficulties, throaty pain, vertigo, headache, loss of pupillary reflexes, hypothermia, cyanosis, mild convulsions. 5.3 Treatment of Exposure: INHALATION: remove victim to fresh air; if he is not breathing, give artificial respiration, preferably mouth-to-mouth; if breathing is difficult, give oxygen; call a physician. EYES: flush immediately with plenty of water for at least 15 min. and call a physician. SKIN: wipe with vegetable oil or margarine, then wash with soap and water. INGESTION: have victim drink water or milk; do NOT induce vomiting. 5.4 Threshold Limit Value: 0.2 mg/m ³ 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Grade 2; LD ₅₀ = 0.5 to 5 g/kg 5.7 Late Toxicity: Repeated exposures may cause cancer of skin. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant. May cause pain and second-degree burns after a few minutes' contact. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 400 mg/m ³			

6. FIRE HAZARDS 6.1 Flash Point: >160°F C.C. 6.2 Flammable Limits in Air: Not pertinent 6.3 Fire Extinguishing Agents: Dry chemical, carbon dioxide or foam 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Data not available 6.6 Behavior in Fire: Heavy, irritating black smoke is formed. 6.7 Ignition Temperature: 637°F 6.8 Electrical Hazards: Not pertinent 6.9 Burning Rate: Data not available 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-X-Y																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 21	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Combustible liquid 11.2 HAZ Hazard Rating for Bulk Water Transportation <table><tr><th>Category</th><th>Rating</th></tr><tr><td>Poison</td><td>1</td></tr><tr><td>Health</td><td></td></tr><tr><td>Vapor Irritant</td><td>2</td></tr><tr><td>Liquid or Solid Irritant</td><td>3</td></tr><tr><td>Poison</td><td>2</td></tr><tr><td>Water Pollution</td><td></td></tr><tr><td>Human Toxicity</td><td>2</td></tr><tr><td>Aquatic Toxicity</td><td>3</td></tr><tr><td>Aesthetic Effect</td><td>4</td></tr><tr><td>Reactivity</td><td></td></tr><tr><td>Other Chemicals</td><td>1</td></tr><tr><td>Water</td><td>0</td></tr><tr><td>Self Reaction</td><td>0</td></tr></table> 11.3 GHS Hazard Classification: <table><tr><th>Category</th><th>Classification</th></tr><tr><td>Health Hazard (Skin)</td><td>2</td></tr><tr><td>Flammability (F+)</td><td>2</td></tr><tr><td>Reactivity (Yellow)</td><td>0</td></tr></table>	Category	Rating	Poison	1	Health		Vapor Irritant	2	Liquid or Solid Irritant	3	Poison	2	Water Pollution		Human Toxicity	2	Aquatic Toxicity	3	Aesthetic Effect	4	Reactivity		Other Chemicals	1	Water	0	Self Reaction	0	Category	Classification	Health Hazard (Skin)	2	Flammability (F+)	2	Reactivity (Yellow)	0
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8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Mixture 12.3 Boiling Point at 1 atm: >366°F = >180°C = >363°K 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.05-1.09 at 15°C (liquid) 12.8 Liquid Surface Tension (est.): 16 dynes/cm = 0.016 N/m at 20°C 12.9 Liquid Water Interfacial Tension (est.): 30 dynes/cm = 0.030 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion (est.): -12,500 Btu/lb = -6,600 cal/g = -389 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.35 Heat of Fusion: Data not available 12.36 Limiting Value: Data not available 12.37 Reid Vapor Pressure: Low																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: Whole creosote or various fractions, depending on boiling point. All have similar properties. 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester)	NOTES																																				

go ohm

OHM/TADS (Version 7.15/9.5 December, 1985) (\$55/Hr.)

Option? type 2/msds.ohm

Conversion to local identifiers resulted in 2 unique occurrences.

	Conversion Entry	1; Accession No.	7216693
(CAS)	CAS Registry Number:	117-81-7	
(SIC)	SIC Code:	2818; 2821	
(MAT)	Material Name:	DIOCTYL PHTHALATE	
(FML)	Chemical Formula:	C ₈ H ₄ (CO ₂ CH ₂ CH(C ₂ H ₅)C ₄ H ₉) ₂	
(USS)	Common Uses:	PLASTICIZER; VINYL RESINS	
(CON)	Containers:	DRUMS, TANK CARS, TANK TRUCKS.	
(FDL)	Detection Limit (Field: Techniques,Ref) (ppm):	800, ESTERS SPOT TEST, (BNW45* 0034)	
(STD)	Standard Codes:	NFPA - - ,1,0; ICC - NO; USCG - COMBUSTIBLE E.	
(FLM)	Flammability:	SLIGHT WHEN EXPOSED TO HEAT OR FLAME.	
(TCP)	Toxic Combustion Prod.:	NO GREAT HAZARD.	
(EXT)	Extinguishing Method:	WATER MAY CAUSE FOAM OR FROTHING. WATER, CARBON DIOXIDE, DRY CHEMICAL, FOAM.	
(FLP)	Flash Point (C.):	218	
(AIP)	Auto Ignition Point(C.):	410	
(EXP)	Explosiveness:	STABLE CAN REACT WITH OXIDIZING MATERIALS.	
(MLT)	Melting Point (C.):	-30	
(BLP)	Boiling Point (C.):	358	
(SOL)	Solubility (ppm @ 25C):	2000	
(SPG)	Specific Gravity:	.986	
(PER)	Persistency:	HALFLIFE IN WATER, 5 DAYS. DISAPPEARS IN 15 DAYS WITH DEGRADATION RESULTING IN PHTHALIC ACID BUILDUP THROUGH A HALF-ACIDE ESTER FORM. (AECTCV 0005) BIODEGRADABLE AT 22-32 DEGREES CELSIUS BY SOIL MICROORGANISMS. (JWPFAS 0028)	
(PFA)	Potential for Accumulation:	AQUATIC INSECTS CAN CONCENTRATE THE ESTER UP TO 13,400 TIMES, BUT SUBSEQUENT EXPOSURE TO CLEAN WATER LEADS TO RAPID DECREASES IN RESIDUAL LEVELS. (ENVRL 0001) POTENTIAL.	
(MUT)	Mutagenicity:	POSITIVE EVIDENCE IS NOTED FOR HIGHER DOSE LEVELS. R57*** 0001) SEMI-STERILITY AND MUTAGENESIS REPORTED IN MICE. (TXAPA9 0051)	
(TER)	Teratogenicity:	POSITIVE. GROSS MALFORMATIONS IN RATS HAVE BEEN NOTED (R57*** 0001).	
(TRT)	Major Species Threatened:	WATERFOWL	
(INT)	Inhalation Limit (Text):	REGULATIONS-- OSHA PEL (TWA) 5 MG/M3 (29CFR* 1910). RECOMMENDATIONS-- ACGIH TLV (TWA) 5 MG/M3 (TLVADM 83/ACGIH) ACGIH STEL 10 MG/M3/15 MIN (TLVADM 83/ACGIH) UPDATED 3/84.	
(ORC)	Direct Contact:	SKIN HAS STRONG IRRITANT REACTION TO INTRADERMAL INJECTION.	
(JNS)	General Sensation:	MILD ODOR.	
(SAF)	Personal Safety Precautions:	AVOID HIGH CONCENTRATIONS OF VAPOR. WEAR CANISTER-TYPE MASK.	

FEREAC 47,26992,82
EPAINF: EPA TSCA SECTION 8(a) STATUS REPORT 8EHQ-0982-0457
OSHMED: MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE
FEREAC 47,30420,82
PESTCL: Acaricide, miticide

Entry 2 CAS RN 117-84-0 NIOSH number TI1925000

MAT: PHTHALIC ACID, DIOCTYL ESTER
FML: C24-H38-04

TOXICITY DATA:

 orl-mus LD50:6513 mg/kg
 ihl-mus LC50:5 mg/m3
 ipr-mus LD50:65 gm/kg

DATA REFERENCES:

CLASS: TERATOGEN
CLASS: SKIN AND EYE IRRITANT
EPAINF: REPORTED IN EPA TSCA INVENTORY, 1983
EPAINF: EPA TSCA 8(a) PRELIMINARY ASSESSMENT INFORMATION, FINAL RULE
FEREAC 47,26992,82
OSHMED: MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE
FEREAC 47,30420,82

CAS RN UNAVAILABLE not in toxicity file

Option?

Category	Rating
Fire	1
HEALTH	1
Vapor Irritant	0
Liquid or Solid Irritant	0
Poisons	0
WATER POLLUTION	1
Human Toxicity	0
Aquatic Toxicity	1
Aesthetic Effect	3
REACTIVITY	1
Other Chemicals	1
Water	0
Self-Reaction	0

Option? go ohm

OHM/TADS (Version 7.15/9.5 December, 1985) (\$55/Hr.)
 Latest Data Base Update: 12/85 - 1,402 Entries Total (See 17 Dec NEWS Message)

Latest news for OHMTADS . . .
 16 Oct 86: New OHM/TADS Manual Now Available!

Option? type l/msds.ohm

Conversion to local identifiers resulted in 1 unique occurrences.

Conversion Entry 1; Accession No. 7216669
 (CAS) CAS Registry Number: 84-74-2
 (SIC) SIC Code: 2879; 2818; 2892
 (MAT) Material Name: \$\$\$ N-BUTYL PHTHALATE \$\$\$
 (FML) Chemical Formula: C6H4(COOC4H9)2
 (USS) Common Uses: INSECT REPELLENT FOR THE IMPREGNATION OF CLOTHING;
 PLASTICIZER; EXPLOSIVES
 (CON) Containers: TANK CARS AND TRUCKS, DRUM CARS, STEEL DRUMS,
 CARBOYS, CANS, BOTTLES.
 (STO) General Storage Procedure: KEEP CONTAINERS TIGHTLY CLOSED. STORE
 IN COOL DRY PLACE AWAY FROM FOOD AND FOOD STUFFS.
 (HND) General Handling Procedure: AVOID INGESTION, CONTACT WITH SKIN
 OR EYES, AND INHALATION. WEAR PROTECTIVE CLOTHING.
 (FDL) Detection Limit (Field; Techniques,Ref) (ppm): 400, ESTER SPOT
 TEST, (BNW45* 0014)
 (LDL) Detection Limit (Lab; Techniques,Ref) (ppm): .002, HIGH-
 PERFORMANCE LIQUID CHROMATOGRAPHY, (JOCRAM 0002)
 (STD) Standard Codes: EPA 311: TSCA: NOT LISTED IATA: NOT LISTED CFR

(FLM) Flammability: SLIGHT WHEN EXPOSED TO HEAT OR FLAME.
 (TCP) Toxic Combustion Prod.: SLIGHT HAZARD.
 (EXT) Extinguishing Method: WATER, FOAM, CARBON DIOXIDE, DRY CHEMICAL.
 (FLP) Flash Point (C.): 157
 (AIP) Auto Ignition Point(C.): 403
 (EXP) Explosiveness: STABLE
 (MLT) Melting Point (C.): -35
 (BLP) Boiling Point (C.): 340 (IGNITES)
 (SOL) Solubility (ppm @ 25C): 4500
 (SPG) Specific Gravity: 1.048
 (VPN) Vapor Pressure (mm Hg): 10; 200
 (VDN) Vapor Density: 9.58
 (PER) Persistency: CERTAIN BACTERIAL STRAINS WILL DEGRADE N-BUTYL PHTHALATE BUT ONLY WHEN THE INITIAL CONCENTRATIONS ARE LOW (HKZAAZ 0001). DEGRADATION WILL TAKE PLACE IN FRESHWATER HYDROSOIL ALSO THROUGH THE ENZYMATIC ACTION OF MICROORGANISMS. ANAEROBIC CONDITIONS WILL SLOW BIODEGRADATION (JFRBAK 0011).
 (CAG) Carcinogenicity: REF. (A1*** 0001). RAT. TUMOR /40. .01-1.25% IN DIET, 1 YEAR.
 (MUT) Mutagenicity: NEGATIVE. NO X-CHROMOSOME MUTATIONS NOTED IN MALE FRUIT FLIES FED SUBLETHAL DOSES (R120** 0001).
 (TER) Teratogenicity: POSITIVE. TERATOGENIC EFFECTS DEMONSTRATED IN RATS (ENVRAL 0001).
 (TRT) Major Species Threatened: MAY SMOTHER BENTHIC LIFE.
 (INH) Inhalation Limit (Value): 9300 (PPM; IDLH)
 (INT) Inhalation Limit (Text): REGULATIONS-- OSHA PEL (TWA) 5 MG/M3 (29CFR* 1910). RECOMMENDATIONS-- NIOSH IDLH 9300 MG/M3 (PKT60* 80/MAC) ACGIH TLV (TWA) 5 MG/M3 (TLVADM 83/ACGIH) ACGIH STEL 10 MG/M3/15 MIN (TLVADM 83/ACGIH) UPDATED 3/84
 (DRC) Direct Contact: LOW (EYE, SKIN).
 (JNS) General Sensation: MILD ODOR.
 (SAF) Personal Safety Precautions: MUST WEAR PROTECTIVE CLOTHING INCLUDING NIOSH APPROVED GLOVES AND BOOTS, SAFETY GOGGLE. CANISTER MASKS SUGGESTED: FOR HIGH CONCENTRATIONS WEAR SELF-CONTAINED BREATHING APPARATUS. PVC IS NOT RECOMMENDED AND RUBBER IS CONSIDERED POOR FOR GLOVES (CHEEA3 0001).
 (AHL) Acute Hazard Level: N-BUTYL PHTHALATE IS OF LOW TOXICITY IN ANIMALS. THE PROBABLE LETHAL DOSE TO A HUMAN WOULD BE BETWEEN 1 PINT AND 1 QUART OF THE MATERIAL (I60*** 0001). THE MAXIMUM SINGLE ORAL DOSE TOLERATED BY RATS IS GREATER THAN 8 G/KG (MEIEDD 0001). THE FRESHWATER TOXICITY, 96 HOUR LC50 FOR FATHEAD MINNOWS IS 1.30 PPM (EVHPAZ 0004). THE LOWEST TOXIC DOSE TO EFFECT THE CENTRAL NERVOUS SYSTEM OF A HUMAN IS 140 MG/KG (I18*** 0001).
 (CHL) Chronic Hazard Level: FRESHWATER SHOULD NOT EXCEED .3 PPB PHTHALATE ESTERS (R184** 0001). NO TOXIC EFFECTS WERE NOTED IN RATS FED MEAL CONTAINING .25% DAILY FOR 1 YEAR (R57*** 0001).
 (HEL) Degree of Hazard to Public Health: INGESTION OF N-BUTYL PHTHALATE COULD LEAD TO CENTRAL NERVOUS SYSTEM DISORDERS. IS RELATIVELY INNOCUOUS. THERE ARE INDICATIONS THAT IT IS A TERATOGEN (I240** 0001).
 (AIR) Air Pollution: THERE WILL BE NO APPRECIABLE VAPOR. AT HIGH TEMPERATURES, THERE WILL BE CARBON DIOXIDE.
 (ACT) Action Levels: STOP FLOW. AVOID CONTACT WITH THE SPILLED CARGO. STAY UPWIND. NOTIFY LOCAL AIR, WATER, AND FIRE AUTHORITIES OF THE ACCIDENT.
 (AML) In Situ Amelioration: DAM STREAM TO REDUCE FLOW AND PREVENT FURTHER DEGRADATION BY WATER MOVEMENT. ACTIVATED CARBON MAY BE

Entry 1 CAS RN 91-20-3

NIOSH number QJ0525000

MAT: NAPHTHALENE

FML: C10-H8

TOXICITY DATA:

ori-chd LDLo: 100 mg/kg
unr-man LDLo: 74 mg/kg
ori-rat LD50: 1250 mg/kg
ori-mus LD50: 533 mg/kg
ipr-mus LD50: 150 mg/kg
scu-mus LD50: 869 mg/kg
ivn-mus LD50: 100 mg/kg
ori-dog LDLo: 400 mg/kg
ori-cat LDLo: 1000 mg/kg
ori-rbt LDLo: 3 gm/kg
ori-gpg LD50: 1200 mg/kg

DATA REFERENCES:

CLASS: AGRICULTURAL CHEMICAL

CLASS: TUMORIGEN

CLASS: MUTAGEN

CLASS: TERATOGEN

CLASS: SKIN AND EYE IRRITANT

OCCER: TLV-TWA 10 ppm; STEL 15 ppm

OSHA: OSHA STANDARD-air: TWA 10 ppm (SCP-T)

OSHA: MSHA STANDARD-air: TWA 10 ppm (50 mg/m3)

DOTST: DOT-HAZARD: ORM-A; LABEL: NONE

DOTST: DOT-IMO: FLAMMABLE SOLID; LABEL: FLAMMABLE SOLID

NTPT: NTP CARCINOGENESIS STUDIES: ON TEST, NOVEMBER 1985

NIOSH: "NIOSH MANUAL OF ANALYTICAL METHODS, 3rd Ed." see: METHOD 1501

EPAINF: REPORTED IN EPA TSCA INVENTORY, 1983

EPAINF: EPA GENETIC TOXICOLOGY PROGRAM, JANUARY 1984

OSHMED: MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE

FEREAC 47,30420,82

PESTCL: Insecticide

PESTCL: Fungicide, bactericide, wood preservative

CAS RN 1146-65-2

not in toxicity file

Option?

(UPN) Vapor Pressure (mm Hg): .23; 1
 (VDN) Vapor Density: 4.42
 (PER) Persistency: BIODEGRADES AT SLOW-MODERATE RATE. HALF-LIFE IN LESS THAN SATURATED SOLUTION (TOP METER) IS ESTIMATED TO BE 2.9 HOURS; AS A RESULT OF EVAPORATIVE LOSSES. 19% EVAPORATES WITH FIRST .01% OF WATER. (ESTHAG 0005 0005 7(7)-,73/MAC).
 (CAG) Carcinogenicity: RAT - TUMOR WAS NEGATIVE - IN OIL (IN SYNTHETIC DIET) 6 TIMES A WEEK, 10-20 MG UNTIL DOSE OF 10 G/RAT IN FOOD.
 (TIC) Taste Imparting Characteristics (ppm): .001
 (INH) Inhalation Limit (Value): 500 (PPM; IDLH)
 (INT) Inhalation Limit (Text): REGULATIONS-- OSHA PEL (TWA) 50 MG/M3 10 PPM (29CFR* 1910). RECOMMENDATIONS-- NIOSH IDLH 500 PPM (PKTGD* 80/MAC) ACGIH TLV (TWA) 50 MG/M3 10 PPM (TLVADM 83/ACGIH) ACGIH STEL 75 MG/M3/15 MIN 15 PPM/15 MIN (TLVADM 83/ACGIH) (TLVADM 83/ACGIH) UPDATED 3/84
 (DRC) Direct Contact: SKIN, EYES, RESPIRATORY TRACT IRRITANT - OCCASIONAL.
 (JNS) General Sensation: MOTHBALL ODOR. METABOLITES OF NAPHTHALENE ARE RESPONSIBLE FOR THE GROWTH OF CATARACTS. (R215** 0001); CAN BE ABSORBED THROUGH SKIN. SYMPTOMS INCLUDE NAUSEA, VOMITING, HEADACHE, DIAPHORESIS, HEMATURIA, HEMOLYTIC ANEMIA, FEVER, HEPATIC NECROSIS, CONVULSIONS AND COMA.
 (LOT) Odor Threshold, Lower (ppm): .003
 (MOT) Odor Threshold, Medium (ppm): .025
 (SAF) Personal Safety Precautions: SAFETY GOGGLES AND RUBBER SHOES WILL SUFFICE FOR ALL BUT THE SEVEREST OF CONDITION. IN CLOSED LOCATIONS BREATHING APPARATUS MAY BE REQUIRED.
 (AHL) Acute Hazard Level: 5-15 GM WILL KILL A MAN. MODERATELY TOXIC BY INGESTION OR INHALATION. WILL PRODUCE TASTES AND BOO IN WATER. HIGHLY TOXIC TO FISH.
 (CHL) Chronic Hazard Level: POSSIBLE DERMATITIS. SLIGHT CHRONIC HAZARD WITH INGESTION OR INHALATION. SOLID MAY STAY ON BOTTOM AND PROVIDE EQUILIBRIUM VALUES FOR PROLONGED PERIODS.
 (HEL) Degree of Hazard to Public Health: IRRITANT. MODERATELY TOXIC VIA ACUTE EXPOSURE. SLIGHT CHRONIC TOXICANT WITH INGESTION OR INHALATION.
 (AIR) Air Pollution: HIGH
 (ACT) Action Levels: NOTIFY FIRE AUTHORITY. IF INTENSE HEAT OR FLAME ARE PRESENT NOTIFY AIR AUTHORITY AND EVACUATE IMMEDIATE AREA. PREVENT SUSPENSION OF DUSTS.
 (AML) In Situ Amelioration: DREDGE SOLID. USE CARBON OR PEAT ON DISSOLVED PORTION. SEEK PROFESSIONAL ENVIRONMENTAL ENGINEERING ASSISTANCE THROUGH EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NO. 201-321-6660.
 (AVL) Aval. of Countermeasure Material: CARBON - WATER TREATMENT PLANTS, SUGAR REFINERIES; PEAT - NURSERIES, FLORAL SHOPS.
 (DIS) Disposal Method: CONTROLLED BURNING CAN BE USED. SPRAY INTO INCINERATOR OR BURN IN PAPER PACKAGING. ADDITION FLAMMABLE SOLVENT MAY BE ADDED.
 (IFP) Industrial Fouling Pot.: VOLATILITY SUGGESTS RUPTURE HAZARD WHEN CONFINED IN BOILER FEED WATER.
 (WTP) Effects on Water Treatment Process: CAN BE TOXIC TO SEWAGE ORGANISMS AT 2500 PPM.
 (WAT) Major Water Use Threatened: FISHERIES, POTABLE SUPPLY, RECREATION, INDUSTRIAL
 (LOC) Probable Location and State of Material: WHITE OR BROWN POWDER. WILL SINK TO BOTTOM OF WATER COURSE.
 (HOH) Water Chemistry: LOOSE NAPHTHALENE WILL VOLATILIZE AT ROOM TEMPERATURE RELEASING A MOTH BALL ODOR. SUBJECT TO

NAPHTHALENE

NTM

Common Synonyms Naphthalen Tar camphor		Solid Colorless Mothballs odor	
		Solidifies and floats or sinks in water.	
Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and solid. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Combustible. Wear goggles and self-contained breathing apparatus. Extinguish with water, foam, dry chemical or carbon dioxide. Cool exposed containers with water.		
Exposure	CALL FOR MEDICAL AID SOLID OR LIQUID Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.		
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shorelines. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent	
3. CHEMICAL DESIGNATIONS 3.1 CB Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C ₁₀ H ₈ 3.3 MSD/WH Designation: 4.1/2304 3.4 DOT ID No.: 2304 3.5 CAS Registry No.: 91-20-3		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Molten solid 4.2 Color: Colorless 4.3 Odor: Coal tar; moth balls	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: U.S. Bureau of Mines approved organic vapor canister unit (USBM Type B); rubber gloves; chemical safety goggles; face shield; coveralls and/or rubber apron; rubber shoes or boots. 5.2 Symptoms Following Exposure: Vapors or fumes are irritating to eyes, nose, and throat and may cause headaches, dizziness, nausea, etc. Solid may be irritating to skin. 5.3 Treatment of Exposure: INHALATION: remove to fresh air. SKIN OR EYES: flush immediately with plenty of water for at least 15 min.; remove contaminated clothing immediately; call a physician. 5.4 Threshold Limit Value: 10 ppm 5.5 Short Term Inhalation Limit: 15 ppm for 5 min. 5.6 Toxicity by Ingestion: Grade 2; oral rat LD ₅₀ = 1780 mg/kg 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Hot liquid can cause severe burn. The solid may irritate the skin. 5.10 Other Threshold: Data not available 5.11 IDLM Value: 500 ppm			
6. FIRE HAZARDS 6.1 Flash Point: 174°F C.C.; 180°F O.C. 6.2 Flammable Limits in Air: 0.8%-5.9% 6.3 Fire Extinguishing Agents: Water fog, carbon dioxide, dry chemical, or foam 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Toxic vapors given off in a fire. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 678°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4.3 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available			
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: Molten naphthalene splatters and foams in contact with water. No chemical reaction is involved. 7.2 Reactivity with Common Materials: None 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Water Ratio (Resistant to Product): Data not available 7.8 Reactivity Group: 32			
8. WATER POLLUTION 8.1 Aquatic Toxicity: 180 mg/l/96 hr/catch/TL ₅₀ /fresh water 1.8 ppm/72 hr/fingering salmon/critical/ salt water 8.2 Waterway Toxicity: Data not available 8.3 Skeletal Oxygen Demand (BOD): (theor.) 58.5%, 6 days 8.4 Food Chain Concentration Potential: None			
9. SHIPPING INFORMATION 9.1 Grades of Purity: Pure; crude: 85% Pure; mp = 176°F Crude; mp = 166-176°F 9.2 Storage Temperature: Elevated 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-relief			
10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-X			
11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: OSHA 11.2 HAS Hazard Rating for Bulk Water Transportation Category Rating Fire 1 Health 2 Vapor Irritant 2 Liquid or Solid Irritant 1 Poisons 2 Water Pollution Human Toxicity 1 Aquatic Toxicity 3 Aesthetic Effect 3 Reactivity Other Chemicals 1 Water 0 Self Reaction 0 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) 2 Flammability (Red) 2 Reactivity (Yellow) 0			
12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 18°C and 1 atm: Solid 12.2 Molecular Weight: 128.18 12.3 Boiling Point at 1 atm: 484°F = 218°C = 491°K 12.4 Freezing Point: 176.4°F = 82.2°C = 353.4°K 12.5 Critical Temperature: 567.4°F = 475.2°C = 748.4°K 12.6 Critical Pressure: 588 psia = 40.0 atm = 4.05 MN/m ² 12.7 Specific Gravity: 1.145 at 20°C (solid) 12.8 Liquid Surface Tension: 31.8 dynes/cm = 0.0318 N/m at 100°C 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.088 12.12 Latent Heat of Vaporization: 145 Btu/lb = 80.7 cal/g = 3.38 X 10 ⁴ J/kg 12.13 Heat of Combustion: -18,720 Btu/lb = -8267 cal/g = -368.8 X 10 ⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: 35.06 cal/g 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: Low			
NOTES			

Entry 1 CAS RN 57-12-5

NIOSH number GS7175000

MAT: CYANIDE

TOXICITY DATA:

ipr-mus LDS0:3 mg/kg

DATA REFERENCES:

OSHA: OSHA STANDARD-air:TWA 5 mg(CN)/m3

OSHA: MSHA STANDARD-air:TWA 5 mg/m3 (skin)

OCCER: OCCUPATIONAL EXPOSURE TO CYANIDE recm

std-air:CL 5 mg/m3/10M

NIOSH: "NIOSH MANUAL OF ANALYTICAL METHODS, 3rd Ed." see: METHOD 7904

Conversion to local identifiers resulted in 1 unique occurrences.

Conversion Entry 1; Accession No. 8400313

(CAS) CAS Registry Number: 57-12-5

(MAT) Material Name: \$\$\$ CYANIDES (SOLUBLE CYANIDE SALTS), NOT
ELSEWHERE SPECIFIED \$\$\$

(HND) General Handling Procedure: NIOSH/OSHA RECOMMENDATIONS FOR
OCCUPATIONAL HANDLING OF CYANIDES (SEE ALSO FIELD SAF FOR
RESPIRATORY PROTECTION). WEAR IMPERVIOUS CLOTHING, GLOVES, 8-
INCH-MINIMUM FACE SHIELDS, AND OTHER PROTECTIVE CLOTHING AS
NEEDED TO PREVENT SKIN CONTACT WITH CYANIDE OR CYANIDE IN
SOLUTION. IF THERE IS ANY POSSIBILITY OF EYE CONTACT, WEAR DUST-
AND SPLASH-PROOF GOGGLES. CHANGE INTO UNCONTAMINATED CLOTHING
BEFORE LEAVING THE WORK PREMISES. PLACE CONTAMINATED OR POSSIBLY
CONTAMINATED CLOTHING IN CLOSED CONTAINERS UNTIL DISPOSAL OR
CLEANING. REMOVE CONTAMINATED NON-IMPERVIOUS CLOTHING
IMMEDIATELY AND DO NOT WEAR AGAIN UNTIL THE CYANIDE HAS BEEN
REMOVED. INFORM THE PERSON(S) PERFORMING THE LAUNDERING OR OTHER
CLEANING OPERATION OF THE HAZARDS OF CYANIDE. AN EYE-WASH
FOUNTAIN AND FACILITIES FOR QUICK DRENCHING SHOULD BE READILY
AVAILABLE FOR EMERGENCY USE. (OHGHC* 81/MAC)

(BIN) Binary Reactants: UNDER CERTAIN CONDITIONS, MOST CYANIDE SALTS
ARE VIOLENTLY OXIDIZABLE. FUSED MIXTURES OF METAL CYANIDES WITH
METAL CHLORATES, PERCHLORATES, NITRATES, OR NITRITES ARE
VIOLENTLY EXPLOSIVE. (BRETH* 79/BRE) REACTIONS WITH EVEN WEAK
ACIDS RELEASE HCN GAS. (OHGCH* 81/MAC)

(ANT) Antagonistic Materials: THIOSULFATE IN WATER CONTAINING CYANIDE
REDUCES THE TOXICITY OF CYANIDE TO AQUATIC ORGANISMS. (EPCN*

78/TOW) ANTIDOTE FOR CYANIDE POISONING--GIVE AMYL NITRITE BY INHALATION AND SODIUM NITRITE INTRAVENOUSLY TO FORM METHEMOGLOBIN, WHICH FIRMLY BINDS THE FREE CYANIDE IONS. THEN GIVE SODIUM THIOSULFATE INTRAVENOUSLY TO SPEED UP THE CONVERSION OF CYANIDE TO THE LESS TOXIC THIOCYANATE. (OHGHC* 81/MAC) CYANIDE POISONING CAN BE ANTAGONIZED BY OTHER COMPOUNDS THAT CAN GENERATE METHEMOGLOBIN IN VIVO. SUCH COMPOUNDS INCLUDE HYDROXYLAMINE, AROMATIC AMINO COMPOUNDS, AND AROMATIC NITRO COMPOUNDS. COBALT COMPOUNDS ALSO ANTAGONIZE CYANIDE POISONING, PRESUMABLY BY COMPLEXING THE FREE CYANIDE. (AWQCD* PB81-117483,80/ECAO)

(LOL) Detection Limit (Lab: Techniques,Ref) (ppm): EPA TEST METHODS (ME014* 78/KOP): CYANIDES, AMENABLE TO CHLORINATION, METHOD 335.1 (TITRIMETRIC; SPECTROPHOTOMETRIC)--FOR DETERMINATION IN DRINKING WATER, SURFACE AND SALINE WATERS, AND DOMESTIC AND INDUSTRIAL WASTEWATERS. CYANIDE LEVELS >1 PPM ARE DETERMINED BY TITRATION AFTER REMOVAL OF THE CYANIDES AMENABLE TO CHLORINATION. AT LEVELS <1 PPM, COLORIMETRY IS USED. CHLORINATE A PORTION OF THE SAMPLE AT PH >11 TO DECOMPOSE CYANIDE. THEN DETERMINE CYANIDE LEVELS IN THE CHLORINATED SAMPLE BY THE METHOD FOR CYANIDE, TOTAL. CALCULATE CYANIDES AMENABLE TO CHLORINATION BY DIFFERENCE. (BASED ON ANNUAL BOOK OF ASTM STANDARDS, PART 31, STANDARD D 2036-75, METHOD B, PAGE 505, 1976, AND STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 14TH EDITION, PP. 376 AND 370, METHOD 413F AND D, 1975.) CYANIDE, TOTAL, METHOD 335.2 (TITRIMETRIC; SPECTROPHOTOMETRIC)-- FOR DETERMINATION OF CYANIDE IN DRINKING WATER, SURFACE AND SALINE WATER, AND DOMESTIC AND INDUSTRIAL WASTE. DETERMINE CYANIDE LEVELS >1 PPM BY THE TITRATION PROCEDURE USING SILVER NITRATE WITH P-DIMETHYLAMINO- BENZAL-

RHODANINE INDICATOR. DETERMINE CYANIDE CONCENTRATIONS <1 PPM (SENSITIVITY, APPROXIMATELY 0.02 PPM) BY THE COLORIMETRIC PROCEDURE. RELEASE HCN BY REFLUX-DISTILLATION, ABSORB HCN IN A SCRUBBER CONTAINING A SOLUTION OF NaOH, AND DETERMINE CYANIDE BY VOLUMETRIC TITRATION OR COLORIMETRICALLY. FOR THE COLORIMETRIC MEASUREMENT, CONVERT CYANIDE TO CYANOGEN CHLORIDE BY TREATING WITH CHLORAMINE-T AT PH <8 . WHEN THE REACTION IS COMPLETE, COLOR IS FORMED ON ADDITION OF PYRIDINE-PYRAZOLONE OR PYRIDINE-BARBITURIC ACID REAGENTS (READ ABSORBANCE AT 620 OR 578 NM, RESPECTIVELY). SULFIDES AND FATTY ACIDS INTERFERE AND MUST BE REMOVED. (BASED ON ASTM METHOD A, PAGE 503 [SEE FULL REFERENCE ABOVE]; STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, METHOD 413B AND D, PP. 367 AND 370; AND OTHER REFERENCES.) CYANIDE, TOTAL, METHOD 335.3 (COLORIMETRIC, AUTOMATED UV)--FOR DETERMINATION OF CYANIDE IN DRINKING AND SURFACE WATERS AND DOMESTIC AND INDUSTRIAL WASTEWATERS. APPLICABLE FOR CONCENTRATIONS OF 0.005 TO 0.5 PPM. RELEASE HCN FROM CYANIDE COMPLEXES BY UV DIGESTION AND DISTILLATION; CONVERT TO CYANOGEN CHLORIDE BY TREATING WITH CHLOORAMINE-T, WHICH THEN REACTS WITH PYRIDINE AND BARBITURIC ACID TO GIVE A RED-COLORED COMPLEX. THIOCYANATES AND SULFIDE INTERFERE. CYANIDE IN AIR MAY BE SAMPLED BY USE OF IMPINGERS THAT CONTAIN 10 ML OF 0.1 M NaOH. SAMPLES ARE ANALYZED BY CYANIDE ION SELECTIVE ELECTRODE. SULFIDE ION POISONS THE CYANIDE ELECTRODE. (NIOSH* I,1,77/TAY) (NIOSH* II,3,77/TAY) TOTAL CYANIDE FROM RELATIVELY NON-DISSOCIABLE CYANIDES AND FROM RELATIVELY DISSOCIABLE COMPLEXES IS DETERMINED BY ACIDIFICATION OF AQUEOUS SAMPLES FOLLOWED BY DISTILLATION AND AIR PURGING. HCN GAS IS COLLECTED IN NaOH SCRUBBING SOLUTION AND CYANIDE CONCENTRATION CAN BE DETERMINED BY TITRIMETRIC, COLORIMETRIC OR POTENTIOMETRIC METHODS.

TITRIMETRY UTILIZES STANDARD AgNO_3 AND AN INDICATOR. COLORIMETRY CONVERTS CYANIDE ION TO CYANOGEN CHLORIDE, WHICH IS ESTIMATED BY A COLOR-FORMING REAGENT. A CYANIDE-SELECTIVE ELECTRODE IN CONJUNCTION WITH AN EXPANDED-SCALE PH METER IS SATISFACTORY. (ME025* 81/APHA) OTHER METAL CYANIDE COMPLEXES OF INTERMEDIATE STABILITY ARE DESTROYED BY CHLORINATION (THAT IS AMENABLE TO CHLORINATION). CYANIDES AMENABLE TO CHLORINATION CAN BE DETERMINED BY (1) ESTIMATING TOTAL CYANIDE BY ACIDIFICATION AND (2) ESTIMATING RESIDUAL CYANIDE AFTER CHLORINATION STEP. THE OBSERVED DIFFERENCE IN CYANIDE VALUES IS QUANTITY OF CYANIDES AMENABLE TO CHLORINATION. (ME025* 81/APHA)

- (STD) Standard Codes: SUPERFUND DESIGNATED (HAZARDOUS SUBSTANCES) LIST. HAZARDOUS (RCRA) WASTE NO. P030. REPORTABLE QUANTITY (RQ): 1 LB (NOT TO BE CONFUSED WITH 1 LB RQ UNDER CLEAN WATER ACT SECTION 311). (STATUTORY SOURCE UNDER CERCLA IS RCRA SECTION 3001.) PROPOSED RQ: 10 LB (4.54 KG) (CATEGORY A). (FEREAC 48FR23551, 5-25-83)
- (EXT) Extinguishing Method: DOT RECOMMENDATIONS--SMALL FIRES: DRY CHEMICAL, CO_2 , WATER SPRAY, OR FOAM LARGE FIRES: WATER SPRAY, FOG, OR FOAM. IF YOU CAN DO SO WITHOUT RISK, MOVE THE CONTAINER FROM THE FIRE AREA. FIGHT FIRE FROM THE MAXIMUM DISTANCE. (85EWAF 80/DOT)
- (EXP) Explosiveness: VIOLENT EXPLOSIONS OCCUR WHEN MIXTURES OF METAL CYANIDES AND METAL CHLORATES, PERCHLORATES, NITRATES, OR NITRITES ARE FUSED. (BRETH* 79/BRE)
- (PER) Persistency: PHOTOLYSIS OF METAL CYANIDES MAY RELEASE CYANIDE ION. IN WATERS AT PH ≤ 8 , MOST FREE CYANIDE WILL BE HCN. VOLATILIZATION OF HCN IS AN IMPORTANT ENVIRONMENTAL TRANSPORT PROCESS. HYDROLYSIS RATES (BOTH ACIDIC AND BASIC) ARE NOT COMPETITIVE WITH THOSE OF VOLATILIZATION OR BIODEGRADATION,

ANOTHER VERY IMPORTANT ENVIRONMENTAL PROCESS. CLAYS, BIOLOGICAL SOLIDS, ACTIVATED CARBON, AND SEDIMENTS SORB CYANIDES, BUT SORPTION IS NOT AN IMPORTANT ENVIRONMENTAL PROCESS. (USPEDU 1,79/CAL)

(PFA) Potential for Accumulation: LITTLE BIOACCUMULATION POTENTIAL FOR CYANIDE. EITHER THE ORGANISM QUICKLY METABOLIZES HCN OR IT DIES DUE TO INTERFERENCE WITH THE ENZYMES ASSOCIATED WITH CELLULAR OXIDATION. HOWEVER, BRODERIUS (1973) REPORTED THAT FISH BIOACCUMULATE METAL CYANIDE COMPLEXES. THE LIVER-GALL BLADDER AMONG BLUEGILL TISSUES SHOWED THE HIGHEST BIOACCUMULATION OF COPPER CYANIDE. (USPEDU 1,79/CAL) THE NATIONAL RESEARCH COUNCIL OF CANADA (LEDUC ET AL., 1982) CAUTIONED THAT IT CANNOT BE ASSUMED THAT "VARIOUS CYANIDE CONTAINING COMPOUNDS HAVE A SHORT RESIDENCE TIME IN NATURAL WATERS". (CONAQ: NRCC13246,82/LED)

(EDF) Etiological Potential: PERSONS WHO WOULD BE EXPECTED TO BE AT INCREASED RISK FROM EXPOSURE: PERSONS WITH A HISTORY OF FAINTING SPELLS (POSSIBLE CARDIOVASCULAR OR NERVOUS DISORDERS). PERSONS UNUSUALLY SUSCEPTIBLE TO THE EFFECTS OF ANOXIA. PERSONS WITH ANEMIA. PERSONS WITH PRE-EXISTING SKIN DISORDERS. PERSONS WITH IMPAIRED LUNG FUNCTION. (OHGHC* 81/MAC)

(CAG) Carcinogenicity: NO CARCINOGENICITY DATA ON CYANIDE WERE FOUND FOR REVIEW IN THE 1980 EPA AMBIENT WATER QUALITY CRITERIA DOCUMENT. (AWQCD* PB81-117483/ECA0)

(MUT) Mutagenicity: NO MUTAGENICITY DATA ON CYANIDE WERE AVAILABLE FOR REVIEW FOR THE 1980 EPA AMBIENT WATER QUALITY CRITERIA DOCUMENT. (AWQCD* PB81-117483,80/ECA0)

(TER) Teratogenicity: NO TERATOGENICITY STUDIES ON CYANIDE WERE AVAILABLE FOR REVIEW IN THE 1980 EPA AMBIENT WATER QUALITY CRITERIA DOCUMENT. (AWQCD* PB81-117483,80/ECA0)

(INH) Inhalation Limit (Value): 50 (MG/M3; IDLH FOR CYANIDE KCN OR

NACN)

(INT) Inhalation Limit (Text): FOR CYANIDE: REGULATIONS-- OSHA PEL
(FOR KCN OR NACN) 5 MG/M3 (29CFR* 1910). RECOMMENDATIONS-- NIOSH
CEILING 5 MG/M3/10 MIN (CRSOE* 77-108,76/NIOSH) NIOSH IDLH 50
MG/M3 (PKTGD* 80/MAC) ACGIH TLV (TWA) AS CN--SKIN 5 MG/M3
(TLVADM 83/ACGIH)

(DRC) Direct Contact: CYANIDE CAN BE ABSORBED THROUGH THE SKIN. IF
THERE ARE CUTS IN THE SKIN, A FATAL DOSE CAN BE ABSORBED. DUSTS
IRRITATE THE EYES AND MAY CAUSE TEARING, WHICH CAN PROMOTE
SYSTEMIC TOXICITY. DUSTS ALSO IRRITATE THE NOSE AND SKIN. STRONG
CYANIDE SALT SOLUTIONS ARE SO CORROSIVE THEY MAY PRODUCE
ULCERATION. CYANIDE ACTS AS A DEFATTING AGENT; PROLONGED
EXPOSURE TO CYANIDE CAN CAUSE DERMATITIS. (OH6CH* 81/MAC)

(JNS) General Sensation: CYANIDE POISONING SYMPTOMS: LOSS OF
CONSCIOUSNESS, CESSATION OF BREATHING, SOMETIMES CONVULSIONS,
AND DEATH FOLLOW INHALATION OR INGESTION OF LARGE DOSES OF
CYANIDE. AT LOWER EXPOSURE LEVELS, EARLY SYMPTOMS OF WEAKNESS,
HEADACHE, CONFUSION, NAUSEA, AND VOMITING, AND SOMETIMES
CONVULSIONS MAY BE FOLLOWED BY UNCONSCIOUSNESS AND DEATH. MILD
INTOXICATION SYMPTOMS INCLUDE WEAKNESS, DIZZINESS, HEADACHE,
AND NAUSEA. SYSTEMIC POISONING CAN ARISE FROM SKIN AND EYE
CONTACT, ESPECIALLY TEARING EYES OR NONINTACT SKIN. (OH6CH*
81/MAC)

(SAF) Personal Safety Precautions: NIOSH/OSHA MINIMUM RESPIRATORY
PROTECTION REQUIRED ABOVE 5 MG/M3--FOR PARTICULATE CONCENTRATION
OF 50 MG/M3 OR LESS, USE ANY SUPPLIED AIR RESPIRATOR OR ANY
SELF CONTAINED BREATHING APPARATUS. FOR GREATER THAN 50 MG/M3
OR ENTRY AND ESCAPE FROM UNKNOWN CONCENTRATIONS, USE SELF
CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN
PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE, OR A

COMBINATION RESPIRATOR WHICH INCLUDES A TYPE C SUPPLIED AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS FLOW MODE AND AN AUXILIARY SELF CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE. FOR FIRE FIGHTING USE A SELF CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE. AND FOR ESCAPE, USE ANY GAS MASK PROVIDING PROTECTION AGAINST HYDROGEN CYANIDE AND PARTICULATES OR ANY ESCAPE SELF CONTAINED BREATHING APPARATUS. (OHGCH* 81/MAC)

(AHL) Acute Hazard Level: INGESTION OR INHALATION OF CYANIDE SALTS MAY BE RAPIDLY FATAL. CYANIDE CAN ALSO AFFECT THE BODY IF IT CONTACTS THE SKIN OR EYES. (OHGCH* 18/MAC)

(CHL) Chronic Hazard Level: NONSPECIFIC EFFECTS MAY OCCUR FROM LONG-TERM EXPOSURE TO CYANIDE. THESE ARE RARE. (OHGCH* 81/MAC)
STUDIES DESIGNED TO SHOW CHRONIC OR CUMULATIVE ADVERSE EFFECTS FROM CYANIDE HAVE REPORTED ONLY NEGATIVE RESULTS. (AWQCD* PB81-117483,80/ECAO)

(ACT) Action Levels: ISOLATE HAZARD AND DENY ENTRY. KEEP UNNECESSARY PEOPLE AWAY. IN CASE OF WATER POLLUTION, CALL LOCAL AUTHORITIES. (BSEWAF 80/DOT)

(AML) In Situ Amelioration: THE ASSOCIATION OF AMERICAN RAILROADS BUREAU OF EXPLOSIVES DOES NOT RECOMMEND ANY IN SITU AMELIORATION STEPS FOR EVERY HEAVY METAL CYANIDE, BUT ITS RECOMMENDATIONS FOR ZINC CYANIDE APPEAR TO BE GENERALLY APPROPRIATE: FOR A LAND SPILL, DIG A PIT, POND, LAGOON, OR OTHER HOLDING AREA TO CONTAIN LIQUID OR SOLID MATERIAL. COVER SOLIDS WITH A PLASTIC SHEET TO PREVENT DISSOLVING IN RAIN OR FIRE-FIGHTING WATER. FOR A WATER SPILL THAT HAS BEEN CONTAINED, NEUTRALIZE WITH AGRICULTURAL LIME (SLAKED LIME), CRUSHED LIMESTONE, OR SODIUM BICARBONATE.

ADD CALCIUM HYPOCHLORITE. ADJUST PH TO NEUTRAL AFTER ALL OF THE CYANIDE HAS BEEN DESTROYED. USE MECHANICAL DREDGES TO REMOVE IMMOBILIZED MASSES OF POLLUTANTS AND PRECIPITATES. (BUXEH* 81/STU) MRI RECOMMENDATIONS FOR UNSPECIFIED CYANIDE SALTS: SEEK PROFESSIONAL ASSISTANCE FROM EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NUMBER (201)321-6660. CONTAIN AND ISOLATE SPILL TO LIMIT SPREAD. CONSTRUCT CLAY OR BENTONITE SWALE TO DIVERT UNCONTAMINATED PORTION OF WATERSHED AROUND CONTAMINATED PORTION. ISOLATION PROCEDURES INCLUDE CONSTRUCTION OF LINED DAMS, INTERCEPTOR TRENCHES, OR IMPOUNDMENTS. SEEK PROFESSIONAL HELP TO EVALUATE PROBLEM AND IMPLEMENT CONTAINMENT PROCEDURES. CONDUCT BENCH-SCALE TESTS PRIOR TO IMPLEMENTATION OF FULL-SCALE DECONTAMINATION PROGRAM. FOR DENSITY STRATIFICATION AND IMPOUNDMENT, REMOVE PRODUCT FROM BOTTOM LAYER BY PUMPING THROUGH MANIFOLD OR BY POLYETHYLENE ROPE COLLECTION OR REMOVE CLARIFIED UPPER PORTION BY SKIMMERS OR SIPHONING. TREATMENT ALTERNATIVES FOR CONTAMINATED WATER INCLUDE SORPTION WITH POWDERED ACTIVATED CHARCOAL, BENTONITE, FILTRATION THROUGH A GRANULAR ACTIVATED CARBON BED (USPEDU 1,79/CAL); CHEMICAL OXIDATION WITH HYPOCHLORITE (PRHBK* 73/SIT) OR POTASSIUM PERMANGANATE; ULTRAVIOLET IRRADIATION WITH OZONE OXIDATION (PRHBK* 73/SIT); ACID HYDROLYSIS; ALKALINE CHLORINATION; CHEMICAL PRECIPITATION; AERATION; EVAPORATION; OR BIODEGRADATION. CONTAMINATED WATER MAY BE IMPOUNDED IN A LINED PIT WITH LEACHATE COLLECTION SYSTEM AND DOMED COVER. TREATMENT ALTERNATIVES FOR CONTAMINATED SOILS INCLUDE WELL POINT COLLECTION WITH TREATMENT OF LEACHATES AS FOR CONTAMINATED WATERS AND BENTONITE/CEMENT GROUND INJECTION TO IMMOBILIZE SPILL. PHYSICALLY REMOVE IMMOBILIZED RESIDUES. ADJUST PH OF RESIDUES TO 8.0 AND APPLY ON LAND AT A CONTROLLED AND MONITORED

WATERSHED TO DESTROY BY ULTRAVIOLET IRRADIATION AND ALKALINE HYDROLYSIS. DECOMPOSE BY ACID HYDROLYSIS. CONTAMINATED SOIL OR IMMOBILIZED RESIDUES MAY BE PACKAGED FOR DISPOSAL. CONFIRM ALL TREATMENT PROCEDURES WITH RESPONSIBLE ENVIRONMENTAL ENGINEER AND REGULATORY OFFICIALS.

(DIS) Disposal Method: PRODUCT RESIDUES AND SORBENT MEDIA MAY BE PACKAGED IN 17H EPOXY LINED DRUMS AND DISPOSED OF AT A RCRA-APPROVED SECURE LANDFILL. DESTROY CYANIDE BY PERMANGANATE OXIDATION, ALKALINE OR ACID HYDROLYSIS, TREATMENT WITH CALCIUM HYPOCHLORITE, CHEMICAL OXIDATION, OR MICROWAVE PLASMA TREATMENT. CONFIRM DISPOSAL PROCEDURES WITH RESPONSIBLE ENVIRONMENTAL ENGINEER AND REGULATORY OFFICIALS.

(WTP) Effects on Water Treatment Process: ACTIVATED SLUDGE TREATMENT CAN GIVE COMPLETE CYANIDE REMOVAL, BUT MOST OF THE LOSS IN SUCH TREATMENT IS FROM VOLATILIZATION. PRACTICALLY ALL ORGANISMS CAN METABOLIZE HCN. (USPEDU 1,79/CAL INHIBITION OF SEWAGE ORGANISMS HAS BEEN REPORTED AT CONCENTRATIONS OF 0.3 TO 5.0 PPM CYANIDE. HOWEVER, EVEN AT 6% CYANIDE, INCUBATION FOR UP TO 10 DAYS PURIFIED ALL WATERS STUDIED BY AT LEAST 50% OF THE CONTROL.

(MOVIS* 77/FUL)

(DRT) Soil Chemistry: CYANIDE ION HAS FAIR MOBILITY IN SOILS. MOBILITY IS LOWEST IN SOILS OF LOW PH WITH HIGH CONCENTRATIONS OF IRON OXIDES AND POSITIVELY CHARGED PARTICLES SUCH AS KAOLIN, CHLORITE, AND GIBBSITE. HIGHEST MOBILITY OCCURS IN SOILS OF HIGH PH WITH HIGH CONCENTRATIONS OF FREE CALCIUM CARBONATE (HIGH NEGATIVE CHARGE) AND LOW CLAY CONCENTRATION. (USPEDU 1,79/CAL) DEPENDING ON THE OXIDATION OR REDUCTION CONDITIONS, UP TO 200 PPM CYANIDE ADDED TO SOIL IS READILY TRANSFORMED AND/OR DEGRADED. IN NONSTERILE SOILS CYANIDE (AS KCN) IS READILY CONVERTED TO CO₂ AND NH₃. (MOVIS* 77/FUL)

Information to be supplied to emergency response personnel will include the nature of the emergency, area involved in the emergency situation, if known, presence of toxic or flammable substances which may be encountered, and other pertinent information. Personnel will not be permitted into the Exclusion Zone/work area until the emergency is resolved, and the all-clear signal is given by the SSO.

In order to prevent the occurrence of potentially hazardous conditions, work area monitoring will be performed as discussed in Section 4.7. In addition to hydrogen cyanide, hydrogen fluoride and organic vapor monitoring, combustible gas measurement will be performed hourly during actual drilling and sediment sampling activities within and around disposal ponds and waste potliner storage areas. If combustible gas concentrations reach 50 percent of the Lower Explosive Limit during drilling or sampling operations, personnel will evacuate the work area and the SSO and Ormet security will be notified. Work will not proceed until concentrations of combustible gas return to below 50 percent LEL, and preferably, below 25 percent LEL.

To prevent potential fire hazards, all vehicle or equipment refueling will take place with the vehicle shut off, and in a safe area without sources of ignition. Fuel for drilling and sampling equipment will be stored and transported in metal jerry can -

type containers which will be properly secured during transit. Dry chemical fire extinguishers (A, B, C type) will be kept aboard drilling equipment and other vehicles entering the Exclusion Zone. Subcontractor drilling equipment and vehicles will be required to meet the pertinent sub-parts of the general Construction Industry Standards, OSHA 29 CFR 1926-1910.

In addition to the above measures, a wind direction indicator will be installed in a conspicuous location which shall be visible from the Exclusion Zone.

4.12.3 Emergency Information Telephone Numbers

♦ Ormet Corporation:

- o Ormet Security - (614) 483-1381 Ext. 370
- Fire Brigade
- Northern Ohio River Mutual Aid Council; NORIMAC

♦ Wetzel County Hospital

- o 3 East Benjamin Drive, New Martinsville,
West Virginia - (304) 455-1212

♦ Clarington, Ohio Emergency Squad - (614) 458-1234

GERAGHTY & MILLER, INC.

Section No. 4.12
Revision No. 2
Date 9-21-87
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♦ Ohio EPA Emergency Response Hotline-1 (800) 282-9378

♦ U.S. EPA Region V Eastern Reponse Unit-(313) 675-3662

4.13 RECORDKEEPING

G&M shall establish and maintain records of all necessary and prudent monitoring activities as described below:

- ♦ The dates, number, duration, and results of air samples taken. These measurements shall be written in an instrument log book.
- ♦ A description of the sampling and analytical methods used;
- ♦ Name, social security number, and job classification of the employees involved on specific tasks;
- ♦ Name and affiliation of each individual issued a copy of the Health and Safety plan;
- ♦ Records of qualitative fit-testing results for subcontractor and G&M employees;
- ♦ Emergency report sheets describing any incidents or accidents; and
- ♦ Records of maintenance of monitoring devices

4.14 ON-SITE TRAINING

G&M will provide site specific training to its personnel and members of the drilling crew involved in the RI activities prior to the start of work, at which time applicable portions of the HASP will be provided. The training session will include the items listed below and emergency instructions for chemical exposure or release, fire or explosion, and personal injury. Any new operations shall be rehearsed prior to performing actual procedures.

- ♦ Site Health and Safety Plan;
- ♦ Physical health hazards identified at the site, including acute and chronic effects of waste constituents;
- ♦ Personal hygiene;
- ♦ Safety equipment and procedures required for personnel protection;
- ♦ Proper use and fitting of respirators;
- ♦ Work zones established at the site;

♦ Prohibitions in contaminated areas:

- o Beards and long sideburns
- o Eating, smoking, chewing
- o Personal articles, e.g., watches and rings
- o Working when ill

♦ Buddy System; and

♦ Medical surveillance

Personnel who have not successfully completed the required training, or who have not met the medical check/approval criteria previously outlined, will not be permitted to enter the Exclusion Zone. Health and safety training specified under OSHA 29 CFR 1910.120 shall be required for G&M and subcontractor personnel taking part in the RI field program.

4.15 SPECIAL PROCEDURES

4.15.1 Ohio River Sediment Sampling

Work teams collecting river sediment samples will wear U.S. Coast Guard approved life preservers when working along or within the Ohio River.

4.15.2 Sample Preparation

Acidification of ground-water samples in order to preserve metals according to USEPA standard procedures may release cyanide within the sample as HCN. Acidification of samples will take place outside of any confined area, with ample ventilation and measurement of HCN via detector tube during the addition of acid to the sample, or beneath a vented laboratory hood.

ATTACHMENT 4-A

ORMET SITE ENTRY PROCEDURES

INTER—OFFICE MEMO



TO E. R. Bolo

AT Hannibal

DATE February 16, 1987

FROM T. A. Hermeling

AT Hannibal

COPY TO

SUBJECT CONTRACTORS WISHING ACCESS
TO PLANT PROPERTY

The following is required of any contractors wishing access to plant property at the Reduction Facility. Excerpts are extracted from the following Ormet Procedures:

P-A-6 - Temporary Visitor/Vehicle Passes
P-IR-15 - Work Access to Plant for Contractors
SP-51 - Plant Protection and Security

SECURITY

Responsibility:

It shall be the responsibility of the Technical Manager or Plant Engineering Superintendent to issue passes for contractors and their personnel, and maintain a log of same.

Only the Plant Manager, Reduction Division, shall have the authority to permit cameras on the Reduction Plant Premises.

Procedure:

1. When a prospective visitor requests permission to visit inside the Reduction Division Main Gate, he/she shall:
 - a. Receive verbal approval of the salaried employee he/she wishes to visit.
 - b. Complete form OR-257 (Attachment I) Visitor/Vehicle Pass - Temporary, as provided by Purchasing and/or Industrial Relations and deliver it to the appropriate individual for approval.
 - c. Passes for vehicles shall include:
Make, model and license plate number.

2. After the Visitor/Vehicle Pass has been approved, he/she shall proceed to the Main Gate Security office and:
 - a. Complete the first vacant line on form OR-30, Visitor's Register, to the satisfaction of the guard on duty.
 - b. Receive the necessary safety apparel from the guard on duty.
 - c. Have the Visitor/Vehicle Pass signed by the assigned escort (who will accompany the visitor throughout the visit when appropriate).
 - d. Receive the necessary plant ID badge (which will be worn by the visitor).
 - e. All construction personnel will be required to have an entry made in the Visitor's Register, OR-30 or Vehicle Register, OR-31.
 - f. Privately owned vehicles will not be permitted access except when deemed necessary by the Ormet engineer in charge, and must then show proof of liability insurance in the amount of \$300,000.
 - g. The number of contractors' vehicles having access into and out of the plant may be restricted by the Company.
3. Upon leaving the plant, the visitor will return to the main gate security office and:
 - a. Return plant ID badge.
 - b. Return the safety apparel to the guard.
 - c. Surrender the Visitor/Vehicle Pass to the guard.
 - d. Record the time in the "time-out" column of the Visitor's Register.
4. Visitors/Contractors visiting areas other than inside the Reduction Plant but still on Ormet property will be required to comply with the above mentioned procedures.

Duties of Plant Security Unit

- Determine that only properly authorized persons are permitted to enter and leave the plant and that such person has the appropriate badge or authorized pass in his or her possession.
- Inspect lunch boxes, handbags, laundry bags and other packages to determine if any unauthorized material is being brought into or removed from plant premises.
- Stop trucks and other vehicles entering the plant to make deliveries and/or to make material pick-ups, and require the driver to sign the Vehicle Register.
- Inspect trucks and other vehicles leaving the plant to insure that no Company property is removed from the plant site without proper bills of lading, shipping papers or authorized passes.
- Regularly patrol Company premises to insure that building and property are secure.
- Coordination and control of plant traffic and parking.
- Control utilization of photographic equipment within the plant based upon approval and conditions established by the Plant Manager.

CONTRACTOR ACCESS

1. Engineering Responsibilities

- (A) Orienting all contractors in the safety aspects of the job and acquainting them with Federal, State, Plant and Departmental Regulations. Provide contractors with copy of Drawing A-SK-202-35-1600 designating hot metal traffic.
- (B) Acting as coordinator between contractor and Ormet supervision to alert both parties of job plans so that operations and contractor may coordinate their activities.
- (C) Preparing special permits: i.e. welding, excavation, flame, etc., for the contractor where possible and appropriate.

- (D) Issuing all necessary permits before work is commenced.
- (E) Inspecting work areas periodically to see that contractors follow prescribed procedures.
- (F) Assuring that the contractor complies with Ormet's requirements including insurance, permits, work rules and housekeeping.

2. Operating Responsibilities

- (A) Observing on a frequent basis the activities of the contractor to insure that the current activity is not going to interfere or jeopardize the operation or the safety of equipment or personnel.
- (B) Taking immediate action when required by the urgency of the situation; otherwise, control of contractor's activities should be made through the project engineer.

3. Safety Department Responsibilities

- (A) Assisting engineering in the safety orientation of the contractor.
- (B) Inspecting work areas periodically to see that safety rules and procedures are followed.
- (C) Supplying contractor with list of safety rules and regulations, form OR-106, (Attachment II).

4. Contractor Responsibilities

- (A) Following all necessary safety rules and procedures specified by the engineering, production and safety departments.
- (B) Following Company rules pertaining to identification and registration of construction employees and their entry to and exit from the plant. Gate passes, OR-257 (Attachment I) or temporary ID badges will be issued by Industrial Relations upon the approval of Manager, Technical. The passes or badges will be issued after work permit for contractors, OR-193 (Attachment III) has been completed by plant engineering.

- (C) Checking with engineering before working on or near any overhead crane or crane rails, overhead powerlines, etc.
- (D) Providing each of his employees with an orientation covering all safety rules, regulations and procedures concerning the job prior to the employee beginning work.


T. A. Hermeling

TAH:smg
Attachments



REDUCTION PLANT

HANNIBAL OHIO

VISITOR PASS

DR 257 REV. 1180

TEMPORARY

THIS PASS
GOOD ONLY
ON THIS DATE

MO. / DAY / YEAR

NAME

ADDRESS

FIRM

PERSON VISITED

SIGNATURE: _____

PASS
RETURNED

DATE

1
SIGNATURE OF VISITOR ESCORT

TIME

2

REC. BY

PASS AUTHORIZED BY

SAFETY RULES AND REGULATIONS

The following are Federal, State or Plant Safety Rules and Regulations by which all Contractor and/or Subcontractor employees are to abide.

1. OSHA Construction Standards 29CFR 1926, and 29CFR 1910.1200 Hazard Communication.
2. All plant procedures must be strictly adhered to; including, but not limited to:
 - a. Lock and Tagout Procedure
 - b. Flame and Welding Permits
 - c. Excavation Permits
 - d. Tank and Bin Entry Permits
3. All ladders used must be equipped with safety feet and must be non-conductive (wood or fiberglass).
4. Plant speed limit is 15 mph on plant roadways and 5 mph in buildings.
5. Contractors are responsible for keeping their work area and production areas free from scrap and materials that may cause injury to construction and production personnel or create a fire hazard.
6. Contractors will meet each shift with production supervisors to insure recognized hazards are controlled.
7. Rope off or barricade all holes or excavations. Use warning lights when the excavation is left open at night.
8. Overhead work signs will be posted when working overhead. The area below the work shall be roped off.
9. Equipment or tools belonging to the Ormet Corporation will be used only with the permission of the Project Engineer and operating department.
10. No Salamanders are permitted in any building.
11. Use safety glasses with sideshields or goggles when using power tools such as chippers, grinders, jackhammers, etc.
12. Hearing protectors must be worn in posted areas of the plant and also when operating equipment which exceeds noise levels of 85 DbA time weighted.
13. Should it be necessary for a contractor to bring onto the plant premises any material, chemical or substance deemed "hazardous" under the provisions of 29CFR1910.1200, copies of the applicable Material Safety Data Sheets shall be made available during the initial Contractor's safety orientation meeting with Ormet Engineering.

SAFETY RULES AND REGULATIONS

page 2 of 2

Special hazards and equipment concerning the following areas:

AREA	PERSONAL PROTECTIVE EQUIPMENT	HAZARDS
Cast House	Safety glasses w/side shields Head covering Long sleeves	Molten metal Overhead loads Mobile equipment Railroad Metal blows
Potrooms	Safety glasses w/side shields Non-conductive shoes or footgear Long sleeves Head covering	Molten metal Overhead loads Mobile equipment Electrical hazards
Rodding Room	Safety glasses w/side shields Hard hat	Molten metal Overhead loads Mobile equipment
Carbon Plant (Green Mill)	Hard hat Safety glasses w/side shields in the 630 Bldg.	Pitch No open flames, sparks, smoking in 630 or 650 Buildings
Carbon Plant (Furnace Rooms)	Long sleeves	Open pits Overhead loads Mobile equipment
Rectifier	Check with Engineer in charge	Electrical
Dry Scrubber	Hard hat Safety glasses w/side shields	Overhead loads Mobile equipment

NOTE: Check with Project Engineer in charge when in doubt of anything not covered above.

Plant Emergency Phone Number 555

Plant Dispensary Phone Number 374

Plant Guards Phone Number 370

(H0H) Water Chemistry: AT PH <7, >99% OF TOTAL FREE CYANIDE EXISTS AS

HCN; AT PH 8, 93.3%; AT PH 9, 58%; AND AT PH 10, 13%. STRONG

OXIDIZING AGENTS CONVERT HCN TO HNCN, WHICH CAN BE HYDROLYZED

VIA CARBAMIC ACID TO AMMONIA, WATER, AND CARBON DIOXIDE. AT PH

<1, HCN ITSELF HYDROLYZES TO AMMONIUM FORMATE (HALF-LIFE 10 TO

1000 HOURS). ALKALINE HYDROLYSIS TO AMMONIA AND FORMATE IS ALSO

SLOW.

HYDROGEN CYANIDE

HCN

Common Synonyms Hydrocyanic acid Prussic acid	Wettable liquid, or gas Colorless Slight almond odor Sinks and mixes with water. Poisonous, flammable vapor is produced and rises. Boiling point is 75°F.
AVOID CONTACT WITH LIQUID AND VAPOR. EVACUATE AREA. WEAR CHEMICAL PROTECTIVE SUIT WITH SELF-CONTAINED BREATHING APPARATUS. Stop discharge if possible. Call fire department. Shut off ignition sources. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.	
Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. WEAR CHEMICAL PROTECTIVE SUIT WITH SELF-CONTAINED BREATHING APPARATUS. Stop discharge if possible. Cool exposed containers and protect men effecting shut-off with water. Let fire burn.
Exposure	CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED OR IF SKIN IS EXPOSED. Irritating to eyes. Move to fresh air. If breathing has stopped, give artificial respiration (but NOT mouth to mouth). If breathing is difficult, give oxygen. LIQUID POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED. Irritating to eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) toxic warning-high flammability, water contaminated Restricted access Evacuate area	2. LABEL 2.1 Category: Poison 2.2 Class: 6
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: HCN 3.3 MSD/UN Designation: 2.8/1081 3.4 DOT ID No.: 1081 3.5 CAS Registry No.: 74-90-6	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to bluish white 4.3 Odor Characteristics: sweetish, like almond
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: CAUTION-Class A poison; absorption can be caused by ingestion, inhalation, or absorption of liquid or vapor through skin (particularly eyes, mucous membranes, and feet). Escape purposes only-air escape mask with 6-minute air cylinder. Work purposes-vapor-proof emergency suit or vapor-protected coverall, plus air mask with clear-view lens, opening diaphragm, demand regulator, and 30-minute air cylinder. Rubber gloves; chemical safety goggles; quick-opening safety shoes. 5.2 Symptoms Following Exposure: Irritation of throat, poisoning, difficult breathing, reddening of eyes, salivation, nausea, headache, weakness of arms and legs, giddiness followed by collapse and convulsions. 5.3 Treatment of Exposure: Call a doctor. If breathing has stopped, give artificial respiration until doctor arrives. INHALATION: remove patient to fresh air. SKIN CONTACT: remove contaminated clothing and wash skin thoroughly with copious quantities of water and soap. EYE CONTACT: hold eyelids apart and wash eyes with continuous gentle stream of water for at least 15 min. If patient is unconscious, administer amyl nitrite by crushing a pearl (capsule) in a cloth and holding this under patient's nose for 15 seconds in every minute. Do not interrupt artificial respiration. Replace amyl nitrite pearl when its strength is spent. Continue treatment until patient's condition improves or doctor arrives. 5.4 Threshold Limit Value: 10 ppm 5.5 Short Term Inhalation Limit: 20 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 4; LD ₅₀ less than 60 mg/kg 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapor is not very irritating but is extremely poisonous. 5.9 Liquid or Solid Irritant Characteristics: Liquid is not irritating but is extremely poisonous if absorbed through skin or eyes. 5.10 Odor Threshold: 1 mg/m ³ 5.11 IDLH Value: 50 ppm	

6. FIRE HAZARDS 6.1 Flash Point: 0°F C.C. 6.2 Flammable Limits in Air: 5.6%-40.0% 6.3 Fire Extinguishing Agents: Stop flow of gas 6.4 Fire Extinguishing Agents Not to be Used: None 6.5 Special Hazards of Combustion Products: Extremely toxic vapors are generated even at ordinary temperatures. 6.6 Behavior in Fire: Containers may explode with ignition of contents. 6.7 Ignition Temperature: 1094°F 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: 1.8 mm/min. 6.10 Auto-ignite Flame Temperature: Data not available 6.11 Backdraft/Smoke Air to Fuel Ratio: 6.360 (Est.) 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-B-C-K-L-M-N																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: Dissolves with a moderate reaction. 7.2 Reactivity With Common Materials: None 7.3 Stability During Transport: May become unstable and subject to explosion if stored for extended time or exposed to high temp. and pressure. 7.4 Neutralizing Agents for Acids and Bases: The weak acidity can be neutralized by alkali base, but this does not destroy the poisonous property. 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Water Ratio (Relevant to Product): Data not available 7.8 Reactivity Groups: Data not available	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Poison, A 11.2 NAB Hazard Rating for Bulk Water Transportation: <table> <tr> <th>Category</th><th>Rating</th></tr> <tr> <td>Fire</td><td>4</td></tr> <tr> <td>Health</td><td></td></tr> <tr> <td>Vapor Irritant</td><td>2</td></tr> <tr> <td>Liquid or Solid Irritant</td><td>1</td></tr> <tr> <td>Poisons</td><td>4</td></tr> <tr> <td>Water Pollution</td><td></td></tr> <tr> <td>Human Toxicity</td><td>4</td></tr> <tr> <td>Aquatic Toxicity</td><td>4</td></tr> <tr> <td>Anesthetic Effect</td><td>1</td></tr> <tr> <td>Reactivity</td><td></td></tr> <tr> <td>Other Chemicals</td><td>3</td></tr> <tr> <td>Water</td><td>0</td></tr> <tr> <td>Self Reaction</td><td>3</td></tr> </table> 11.3 NFPA Hazard Classification: <table> <tr> <th>Category</th><th>Classification</th></tr> <tr> <td>Health Hazard (Blue)</td><td>4</td></tr> <tr> <td>Flammability (Red)</td><td>4</td></tr> <tr> <td>Reactivity (Yellow)</td><td>2</td></tr> </table>	Category	Rating	Fire	4	Health		Vapor Irritant	2	Liquid or Solid Irritant	1	Poisons	4	Water Pollution		Human Toxicity	4	Aquatic Toxicity	4	Anesthetic Effect	1	Reactivity		Other Chemicals	3	Water	0	Self Reaction	3	Category	Classification	Health Hazard (Blue)	4	Flammability (Red)	4	Reactivity (Yellow)	2
Category	Rating																																				
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Category	Classification																																				
Health Hazard (Blue)	4																																				
Flammability (Red)	4																																				
Reactivity (Yellow)	2																																				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 0.14 ppm/72 hr/young brood/TL ₅₀ /fresh water 0.089 ppm/94 hr/1st parh/TL ₅₀ /salt water 8.2 Waterborne Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 27.02 12.3 Boiling Point at 1 atm: 75.3°F = 25.7°C = 298.9°K 12.4 Freezing Point: 5.1°F = -15.3°C = 258.9°K 12.5 Critical Temperature: 392.5°F = 198.6°C = 469.7°K 12.6 Critical Pressure: 739 psi = 50 atm = 5.07 MPa/m ² 12.7 Specific Gravity: 0.899 at 20°C (liquid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Intake: Not pertinent 12.10 Vapor (Gas) Specific Gravity: 0.5 12.11 Ratio of Specific Heats of Vapor (Heat): 1.308 12.12 Latent Heat of Vaporization: 444 Btu/lb = 347 cal/g = 14.5 X 10 ³ J/kg 12.13 Heat of Combustion: -10,980 Btu/lb = -804 cal/g = -345.3 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: 74.36 12.18 Limiting Values: Data not available 12.19 Reid Vapor Pressure: Data not available																																				
9. SHIPPING INFORMATION 9.1 Grade of Purity: 99%; sometimes shipped as a water solution, or absorbed on an inert solid. All forms are extremely toxic. 9.2 Storage Temperature: Data not available 9.3 Inert Atmosphere: May be needed 9.4 Venting: Data not available	NOTES																																				

HYDROGEN FLUORIDE

HF-X

Common Synonyms Hydrofluoric acid, anhydrous		Liquid	Colorless	Sharp, irritating odor
		Sinks and mixes with water. Poisonous vapor is produced and slowly rises. Boiling point is 67°F.		
AVOID CONTACT WITH LIQUID AND VAPOR. Keep people away. Wear chemical protective suit including self-contained breathing apparatus. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	Not flammable. Flammable gas may be produced on contact with metals. Wear chemical protective suit including self-contained breathing apparatus.			
Exposure	CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED. Irritating to eyes, nose and throat. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID POISONOUS IF SWALLOWED. Will burn skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.			
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Isolate warning-pollution, corrosive Resist acids Evacuate area Disperse and flush		2. LABEL 2.1 Category: Corrosive 2.2 Class 8		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: HF 3.3 MSD/UN Designation: 2.8/1082 3.4 DOT ID No.: 1082 3.5 CAS Registry No.: 7664-38-8		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Pungent, Irritating		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Acid-resistant hat, safety goggles, face shield, jacket, overalls, gauntlet-type gloves, and boots. The goggles and face shield must have plastic lenses. There must be a shower and an eye wash. Observe all precautions contained in the Manufacturing Chemists' Association Chemical Safety Data Sheet 8D-85. 5.2 Symptoms Following Exposure: Severe and painful burns of eyes, skin and respiratory tract; pulmonary edema. 5.3 Treatment of Exposure: INGESTION: have victim drink water or milk; do NOT induce vomiting. SKIN: flush with water; consult physician. EYES: flush with water for at least 15 min.; consult physician. 5.4 Threshold Limit Value: 3 ppm 5.5 Short Term Inhalation Limit: 3 ppm for 15 min. 5.6 Toxicity by Ingestion: Oral LD_{50} = 80 mg/kg (guinea pig) 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Skin) Irritant Characteristics: Vapors cause severe irritation of eye and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations. 5.9 Liquid or Solid Irritant Characteristics: Severe skin irritant. Causes second- and third-degree burns on short contact; very injurious to the eyes. 5.10 Odor Threshold: 0.03 mg/m ³ 5.11 IDLH Value: 20 ppm				
6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Toxic and irritating vapors are generated when heated. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazards: Not pertinent 6.9 Burning Rate: Not flammable 6.10 Autotank Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: Classifies with Section of heat. 7.2 Reactivity With Common Materials: Will attack glass, concrete and certain metals, especially those containing silica, such as cast iron. Will attack natural rubber, leather, and many organic materials. May generate flammable hydrogen gas in contact with some metals. 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Corrosives: Flush with water; apply powdered bicarbonate, sodium bicarbonate, or sodium carbonate. 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Water Reactions (Precaution for): Products: Data not available 7.8 Reactivity Group: Data not available				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 60 ppm/24 hr/fish/brack water. These points not specified. 8.2 Waterbody Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None				
9. SHIPPING INFORMATION 9.1 Grade or Purity: 99.995% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Safety relief				
10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-C-K-M-N-O ₂				
11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Corrosive, material 11.2 HAZ Hazard Rating for Bulk (Range): Transportation Category Rating Flam. 0 Health Vapor Irritant 4 Liquid or Solid Irritant 4 Poison 4 Water Pollution Human Toxicity 4 Aquatic Toxicity 3 Acute Effect 2 Reactivity Other Chemical 4 Water 2 Self Reaction 0 11.3 NFPA Hazard Classification Category Classification Health Hazard (Blue) 4 Flammability (Red) 0 Reactivity (Yellow) 0				
12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 20.01 12.3 Boiling Point at 1 atm: 67.1°F = 19.5°C = 282.7°K 12.4 Freezing Point: -124°F = -86.7°C = 187.2°K 12.5 Critical Temperature: 46°F = 8.3°C = 281.5°K 12.6 Critical Pressure: 1180 psia = 74.8 atm = 7.69 MPa 12.7 Specific Gravity: 0.988 at 15°C (liquid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Vapor Interfacial Tension: Not pertinent 12.10 Vapor (Skin) Specific Gravity: 0.7 12.11 Ratio of Specific Heats of Vapor (Skin): 1.289 12.12 Latent Heat of Vaporization: 145 Btu/lb = 85.6 cal/g = 3.57 X 10 ⁵ J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: -1325 Btu/lb = -734.6 cal/g = -30.76 X 10 ³ J/kg 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: 54.7 cal/g 12.18 Melting Point: Data not available 12.19 Solid Vapor Pressure: High				
NOTES				